Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

VOL. LIII. NEW YORK, SATURDAY, JANUARY 2, 1909. No. 1.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

JAMES H. McGRAW, President.
J. M. WAKEMAN, 1st Vice-President. A. E. CLIFFORD, 2d Vice-President.
CURTIS E. WHITTLESEY, Secretary and Treasurer.

239 WEST THIRTY-NINTH STREET, NEW YORK.

TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE.....590 Old Colony Building
CLEVELAND OFFICE.....1015 Schofield Building
PHILADELPHIA OFFICE.....Real Estate Trust Building
EUROPEAN OFFICE....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico.....per year, $3.00
Dominion of Canada..... " " 4.50
Other Foreign Countries within the Postal Union..... " " 6.00
25 shillings. 25 marks. 31 francs.

Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to January, 1907, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of ELECTRICAL WORLD *for 1908 was 898,000. Of this issue 25,000 copies are printed.*

NEW YORK, SATURDAY, JANUARY 2, 1909.

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CHART FOR USE IN TRANSMISSION LINE PROBLEMS.

A chart devised by Prof. L. A. Herdt for the convenient calculation of the size of copper conductors in transmission lines is described on page 36 of this issue, the chart itself being printed on a separate sheet for ready reference. The chart is in reality a large-scale reproduction of that small portion of the vector diagram of e.m.f. relations in a transmission system which deals with the resistance and the reactance volts. By drawing this portion of the diagram to an enlarged scale, work with the chart is greatly facilitated, because almost all of the required calculations are limited to this portion, while the few involving the omitted portion can be made by means of certain simplifying assumptions that introduce only slight errors. The simplifications relate to the use of the sine or tangent line as a substitute for the arc, so that the errors are not large when the angle is small. Moreover, on account of the fact that the successive sizes of B. & S. gage wires differ by more than 25 per cent it is evident that the small error due to the trigonometric substitution is of no importance in problems connected with transmission lines where the choice is always limited to standard sizes of wires.

THE WATER-POWER SITUATION.

The past season of extraordinarily low water throughout the East, a report of which we publish in other columns, has sorely tried the managers of many hydro-electric plants, and has compelled the use of steam reserves to a very unusual extent. In fact, the situation has been a serious one and has created not a little alarm. The question of the real economy of water powers has been often raised and the answer this year has not always been satisfactory to the owners. In developing a water power without large storage one is constantly between the devil and the deep sea. If the plant is designed for average flow, say, the normal June figure, which is often taken, it is quite certain to run far below this rating during parts of the three subsequent months. If, on the other hand, it is planned for the average August or September flow, water in large amounts will be flowing over the dam the rest of the year. If much of the machinery is idle for three months in the year, the plant is heavily burdened with fixed charges. If one undertakes a costly development one ought to be able to use the water on a large scale in order to make both ends meet. Much depends, of course, on the nature of the load undertaken. If, as commonly happens, it is mainly motor service, the load does not vary much with the seasons and the deficit of power has to be made up by costly steam reserves. A load consisting chiefly of lamps to a considerable extent adjusts itself to the seasons, and if storage sufficient for a day or two can be obtained, the service can be very economically conducted. On Eastern

streams such storage would generally be able to tide over the brief midwinter periods of low water.

But in the case of Eastern streams which have been extensively developed even such storage is rarely available, the reservoir capacity being commonly measured in hours instead of days, and even a lighting load requires considerable reserve. Mr. Dunham, of the Hartford plant, who has had a long experience with hydro-electric work, reports that owing to the large fixed charges and the uncertainty of flow, his power from water costs about the same as if it were generated by steam, and in fact it would not surprise us if in this case the balance might turn out to be in favor of the latter. There is good reason to believe that, counting everything, a number of other Eastern plants are in the same fix. Far too little attention is paid to minimum flow conditions in designing hydro-electric plants. The data on flow are often very imperfect, and long chances are taken on the real minimum on the basis of a dry year like the one just ended. Deficit of water implies either shutting down part of the load or supplying it from a steam plant, which adds a serious burden of fixed charges. It has in the past often been possible for water-power companies to sell a large amount of their output as purely secondary power, to be shut off in times of low water. When this can be done the situation is greatly relieved. But hydro-electric plants can rarely find a good market for secondary power at the present time. They commonly supply relatively few large consumers—such as those which originally clustered about the chief water powers—able at short notice to run independently of the full water supply. The consumers demand primary power available every working day in the year, and object to the trouble of maintaining their own reserve plants even when there would be real economy in so doing.

Under existing conditions it is pertinent to inquire regarding possible remedies. Probably the main thing is to proceed more carefully in planning the original development, so as to know beforehand the probable extreme conditions which must be met. And the next thing is to exercise rigid economy in making the hydro-electric development. One can perhaps afford to be lavish in building a plant which may be worked at full output 24 hours per day, if such a thing be possible, but to expend good money on fancy "fixings" in a system, the greater part of which will lie idle most of the time, is simply foolish. Yet it takes some strength of mind to resist the pleadings of interested parties who admonish one to "stick to the latest 'standard' practice," pointing out as an example a plant put through by smooth-talking promoters who felt the need of something imposing to show the bondholders where their money went. An over-built plant constructed to suit the latest tenets of the "catalog engineers" is very likely indeed to come to grief during a long period of low water, whereas a development of conservative size built without any expensive frills and with an eye solely to utility can pull through without much difficulty and without expense that drags down the profits for the rest of the year. And whatever the nature of the plant, a great help in any case is load that can be put on and taken off as occasion may require. It is to be hoped that some of the electrochemical industries can be made available in this function. Most of them are now worked as continuous processes, but if secondary power can be had very much cheaper than absolutely continuous power, it may pay well to take advantage of it, especially if the output of the works can be so regulated as to utilize a large amount of water that now runs to waste. In short, it may pay in the near future for a hydro-electric company to undertake electrochemical industries with the view of fully utilizing its own secondary power.

Electrical Growth in 1908.

It will doubtless be generally agreed that the trade and commerce of the United States were not carried to any new high levels in the past year. So far from expansion being the case, the data are known in regard to many lines of industry, and with great uniformity they reveal restriction. Unquestionably there has been a revival since the uncertainties of the Presidential election passed away, but it has not gone so far as expected, being checked again by the tariff agitation. The year began in great gloom, but while recovery was noted as the months advanced, not unfrequently has there been felt the sickening sense of hope deferred. What can be said is that the tendency is now all one way, toward normal activities in every branch; and the stock exchanges are busy, as usual, discounting the return of prosperity by a brisk advance in the prices of securities. Trade has been stimulated moreover by somewhat lower prices for raw materials, although these have held their own in an extraordinary manner through the period of dull demand now lasting nearly 15 months. There is a feeling that on the whole the recovery has been about as rapid as proper conditions of lasting health would admit.

To sum up the results in the electrical field during such a year is unusually difficult. Admittedly 1908 was not much, if any, better than 1907, on the whole; but was it better than or equal to 1906? The bases for accurate estimates are quite difficult to find, and the area to be surveyed is more extensive than ever. The temptation to the cautious is to set the figures a little lower than 1907 and to present smaller totals. The following table may be taken as a fair approximation to what probably was done as the electrical business in the way of sales and earnings in 1908:

	1907.	1908.
Electrical apparatus	$275,000,000	$250,000,000
Electric railways	350,000,000	350,000,000
Central stations	225,000,000	225,000,000
Telephony	200,000,000	200,000,000
Telegraphy and cable	55,000,000	50,000,000
Isolated plant supply	100,000,000	75,000,000
Miscellaneous	50,000,000	40,000,000
	$1,255,000,000	$1,190,000,000

It will be seen that a slight actual falling off in sales of electrical apparatus is assumed, and the larger companies all report this to be the case; although there are numerous instances where smaller concerns, more flexible, have actually done a larger business than before. It is assumed that the totals will stand for trolleys and lighting, without any gain, and yet some gains are reported. The Interborough Subway System has beaten all its records. The Chicago Edison overran its highest previous peaks a month ago, while the Brooklyn Edison gave its increase in definite percentage. In telephony there has possibly been a gain, but none is assumed. One of the largest systems in the country, that of New York, has been under repression for a year; and in other cities there was marked dullness. This, however, was offset by activity in many smaller towns and in the country districts, leaving the gross income at least equal to that of the previous year. Telegraphy

has been struggling against the effects of the strike, and it is understood that cabling has felt the world-wide slackening of commerce. Isolated plant service and supply unquestionably fell off. Very few new plants were put in and a great many had slight call upon them, with factories and mills shut down or on half time. In like manner the miscellaneous uses of electricity were checked, from moving-picture work and phonographs down to train signaling and push-buttons. All have had to await the turn of the tides of industry, now happily to be seen swelling and filling their banks up to the longing expectant brims. Meantime we feel that the above estimates may be taken as conservative. As new facts emerge from day to day, the items might vary a little here and there, but the aggregate given is rather a minimum than a maximum.

DETERMINATION OF THE MEAN SPHERICAL INTENSITY OF A SOURCE OF LIGHT.

The ordinary photometric method of measuring a source of light determines, as is well known, a polar curve of mean intensity commencing at the zenith, and descending, through the equator, to the nadir. The polar curve of intensity supplies directly the maximum candlepower of the source, and also the candlepower at any particular angle of elevation or depression, but it does not show the mean spherical candlepower. In fact, a trained photometrist, comparing two correctly drawn polar intensity curves, taken from two different light sources, may be unable to decide which of the two sources has the greater mean spherical intensity. It is necessary either to use a spherical candlepower photometer for the comparison of the two light sources, or to evaluate the mean spherical candlepowers from the polar intensity curves by some process of reduction.

There are two known kinds of reduction from the polar intensity curve to the mean spherical intensity, namely, graphical processes and computative processes. Each of these kinds of reduction has its advantages and disadvantages. The graphical processes dispense with computation, employing geometry instead of arithmetic. The computative processes are inherently swifter than any graphic process of like precision, when a large number of reductions have to be made, and when the observations are all tabulated with a view to rapid computation, especially if the slide rule is used. Moreover, some persons prefer geometry to arithmetic, and *vice-versa*. There are two known diagrams for effecting the graphic process of reduction, namely, the Rousseau diagram and the Kennelly diagram. The former develops a certain area from the polar curve, the surface of which area measures the mean spherical candlepower. The latter develops a certain straight line from the polar curve, the length of which line measures the mean spherical candlepower. Both diagrams require a certain number of equal angular zones to be selected. The former usually adopts 10-degree zones; the latter usually adopts 20-degree zones. There are two well-established principal computative methods for reducing the polar curve observations to the corresponding mean spherical intensity, as described; for example, in Palaz's "Treatise on Industrial Photometry." Each of these methods multiples the mean intensity through a certain angular zone by a constant related to the spherical surface area of that zone, and the sum of all these zonal products is the mean spherical intensity required.

In a recent issue Mr. E. W. Weinbeer contributed a notable article, in which a particular variety of the computative method is carried out with the aid of an ingenious specially constructed slide-rule designed solely for this purpose, and, second, a mixed geometrical and computative method, in which some of the steps of the ordinary computative process are effected geometrically, including geometrical addition. The second method is neither purely geometrical nor purely arithmetrical, but a blending of the two. There can be little doubt that when the polar intensity curve is suitably laid out, Mr. Weinbeer's slide-rule method will beat any geometrical method in swiftness. His slide rule assigns ten units to each zonal candlepower, and, in nearly all parts of his scale, a unit is divided into halves. Some numerical adjustment of the scale of magnitude might be needed, in particular cases, to adapt this slide-rule scale to the polar curve radii. For instance, a lamp that varied in intensity between 25 candles and 0 candle would give a polar curve whose radii would be ill adapted for precise use with the new slide-rule unless all were multiplied, say by 4. Apart from this detail, the Weinbeer slide-rule method bids fair to be most useful in the hands of a photometrist who has to reduce many polar curves. The weak point of the method is that if any error has been made in the steps of the slide-rule computation there is nothing in the final result to reveal the error; whereas, in either of the two diagrams above referred to the geometrical construction is a permanent check on the result, and is always open to inspection in case of doubt. It must also be remembered that the slide-rule result is not a mean-spherical intensity, unless the polar curve is limited to either the upper or lower hemisphere. The slide-rule result is a mean hemispherical intensity. In the case of, say, an ordinary incandescent lamp, the slide-rule process should be repeated for both the upper and lower hemispheres, taken from the polar curve, and the arithmetical mean of the two slide-rule results will be the mean spherical candlepower. For most practical purposes, however, these considerations do not materially affect the intrinsic value of the Weinbeer methods, which will doubtless meet with wide application.

PUBLIC SERVICE COMMISSIONS.

An address delivered recently by Mr. Thomas M. Osborne, member of the New York Public Service Commission, Second District, criticised the use of what he termed a political catchword, "government by commission." Whatever may have been the origin of this phrase, the idea which it suggests is one that has been instrumental in checking the progress of radical proposals toward the regulation of all public utility corporations of the country. It appears to be now generally accepted that when free of extreme features of commission control, the supervision of the affairs of public service corporations may be conducted by the State on a wholesome basis, which should work to the ultimate benefit of the corporations as well as of the people they serve. It thus seems that acquiescence and cooperation in the strong demand for regulation on a proper basis should be the controlling attitude of public utility corporations. If reasonable regulation is not accepted willingly, it appears likely that one of two results will ensue eventually: Either (1) regulation will take a form that will be wholly unwise and objectionable, or (2) the hostile element of the public will agitate for the purpose of creating a movement toward municipal ownership. Neither of these courses would

be advantageous to the community at large; either would mean a long period of conflict between interests which should work in such harmony as is compatible with the necessarily somewhat conflicting interests of buyer and seller. The question of what constitutes reasonable supervision is one on which it is difficult to preserve the balance evenly if the desire is to assure justice to the various interests concerned. If laws are enacted that are measurably acceptable to the people of the community, to the corporation furnishing the service and to the members of the commissions which adjudicate upon the claims presented, there still enters the personal equation which affects all calculations even under prescribed methods of control and operation. The intent of the law, however, may be to assure good service without discriminative rates to the public, and, on the part of the public, the acceptance of rates which under ordinary circumstances will afford a reasonable return on the investment. If, by proper accounting and financial methods, the investment is safeguarded for the owners of the bonds and stocks and the property is administered with efficiency, the outcome, in a developing community that needs the service rendered, should be beneficial to all. If supervision by the State contributes to the production of these ideal conditions it will be of public service in its broadest sense and cannot fail to include the protection of the corporation from political and other evils that are real.

The fact that the desires of the public toward public utility corporations appear to have crystallized definitely in the direction of State regulation is well understood by observers of the situation, and might be unimportant to repeat were it not that the tendency which has found expression in the enactment of laws in several States is now manifest in drafts of new bills which are pending or awaiting introduction in the law-making bodies of many commonwealths. Without using improper means of influence, the corporations should be able to cooperate in the work of framing tentative laws based on the principle of supervision. The public service commission's laws of New York, representing the apotheosis of the radical idea of State regulation, was made possible in its present form only by the disclosures of the life insurance investigation and various corporate abuses that came to light about the time that was concluded. The clamor about scandals aroused public sentiment to such an extent that legislation on this subject, for which a way had been prepared by agitation started originally for political purposes, took on a radical aspect that was alarming. Though it be admitted that the agitation respecting corporations which has convulsed the country had its origin in unworthy political motives, and that the evidences of corporate abuse of power in some quarters strengthened the arguments of those who beset the corporations, the movement would probably never have reached the full extremes to which it finally went if officials of other companies had endeavored to meet the attacks half-way and striven to secure legislation that would be reasonable.

An indication of the effect which the lessons of 1908 will have upon the legislation of 1909 may be found in the drafts of some of the measures which are now under consideration. In the State of Connecticut, for instance, the preliminary draft of the public utilities act, which has been submitted to the public for criticisms and suggestions before the commission which framed the measure makes a final report to the General Assembly, contains a section making specific provision for court review of the decisions of the proposed commission. The omission of a provision of this nature from the public service commission's law of New York State has been criticised widely and with much justice. The principle of public utility regulation is now so fortified as a national doctrine that to contest it is futile; all effort should therefore be concentrated to insure that its application will promote, not hamper, the development of needed service and protect the property rights involved.

The Tungsten Lamp Situation.

A word of warning seems to be in order about the 25-watt tungsten lamp. It is certainly a most handy size and one that is bound to be popular, but it must be dealt with rather cautiously. It is somewhat more fragile than others of its kind and while it gives excellent life if let alone it will not generally stand rough treatment. If there is need to clean the shade the lamp should first be lighted and current kept on until the cleaning is done. It is of just about the size of the ordinary 16-cp lamp and unluckily, therefore, fits the old 16-cp fixtures and shades. Therefrom spring difficulties in illumination. The larger part of 16-cp fixtures have the lamps pointing downward at an angle and so located that the lamp is in pretty plain view. Now, with a carbon filament this is bad enough, but it is easy to get frosted lamps and so reduce the intrinsic brilliancy to reasonable limits. Up to the present there has been difficulty in getting frosted 25-watt tungsten lamps, so that this size, which really goes into the most exposed places, is commonly bare and with its enormous filament brightness, is always ready for mischief. There ought to be a special effort on the part of the manufacturers to put out frosted lamps, which are the only ones suitable for use in a large proportion of existing fixtures.

As to the general properties of the present crop of tungsten lamps, they are reasonably satisfactory. More care is being taken with the anchoring, so that it is practicable to burn most of the sizes, perhaps all, out of the perpendicular without any specially bad results—indeed, in most cases with impunity. The commonest fault is blackening, which now and then is very troublesome. When a tungsten lamp does blacken it usually makes a thorough job of it in rather short order. As the manufacture shifts more and more to tungsten, this trouble from blackening will very likely be reduced, but until it is there will be plenty of wrathful users bemoaning dim lamps to be replaced at a dollar or so each. The average working life, barring blackening, seems to be lengthening and the ordinary claim of 800 to 1000 hours of life is well substantiated. It is quite likely that by a rather small sacrifice of efficiency this life might be very considerably increased, and, indeed, it yet remains to be shown what the most economical efficiency really is. The most striking thing in the present stage of tungsten lamp exploitation is the number of arc lamps that are being replaced all over the country. The common 4-amp or 5-amp enclosed arc is a marvel of inefficiency, and three or four 100-watt tungsten lamps will generally replace it with excellent results. Hence there is a procession of arc lamps headed for the scrap-heap. They will have few mourners except the central-station men

who bought them when they became the fashion. Next to the arc lamp the Welsbach is the chief thing superseded by the tungsten lamp. In the green ghastly stage it is an easy victim of the tungsten lamp salesman, and not even the inverted form can often hold its own. The tiny 2 ft. per hour mantle is less easy to kill off, chiefly because it is used largely in residence work where the electric rates are commonly high. But the change to tungsten lamps is now going on with extraordinary rapidity, and with the 25-watt size in hand, economical residence lighting will be an easier problem.

SOME QUESTIONS OF RATES.

The increasing use of tungsten lamps raises some rather important questions regarding methods of charging for current and a suitable basis of rates. As the starting point, the central station must confront the fact that for approximately equal lighting the consumer who uses tungsten lamps requires only about a third of his previous supply of energy. Fear of real loss of income we have every reason to believe to be unfounded, since cheaper supply invariably tends to larger use. But in the case of a very large number of American stations the price of current contains implicitly a charge for lamp renewals, and the question at once arises as to what shall be done with this renewal factor when the relatively costly metallic-filament lamps come into extensive use. Suppose for the sake of argument that this renewal factor is 10 per cent of the total price, which is probably not very far amiss. Does not the customer who installs tungsten lamps thereby relieve the station of the renewal factor and hence virtually pay a premium of about 10 per cent for the current he uses under the new conditions? If so, is this not, so far as net income is concerned, a partial offset for the reduced consumption? Thus while the current sold is greatly diminished by the new lamps, the station virtually gets a slightly better price for it so long as it does not go in for free renewals, or renewals below cost.

On the other hand, the plant that can undertake free renewals of costly and somewhat fragile lamps must indeed be in a charitable frame of mind. To break even on free renewals the tungsten lamp should have something like four times the life of a carbon lamp if it is to remain at or about the present cost. At present the tungsten costs perhaps four times as much as the carbon lamp, but its life so far is, roughly, only about twice as long, so that in furnishing it free the station had to double the renewal costs—that is, upon our previous hypothesis, a free renewal policy is equivalent to a cut of fully 10 per cent in actual price, superimposed on the reduction of output. Only stations operating at a pretty stiff margin of profit could take such a suggestion philosophically. Besides, there is a certain additional moral hazard, so to speak, in the use of a costly lamp, which must have an exceptionally long life to even up its high price, particularly when it is somewhat fragile to boot. The life of a lamp as ordinarily figured does not include the element of accidental breakage. The carbon lamp, indeed, is not subject to this save in the form of actual fracture of the glass. The tungsten lamp involves then a new element of risk which must be taken into account in reckoning its real life—the chance of filament breakage. In careful hands and with the certainty of paying for breakage, this risk is not great. In the service of the ordinary consumer and at the risk of the central station, we are inclined to think that the breakage hazard is a considerable one. It is probably too early to secure any data on the fate of tungsten lamps in service complete enough to serve for the estimate of the relative importance of breakage, but we are inclined to think that in case of free renewals the laboratory life, so to speak, would be shortened by something like a half.

This means that a free renewal policy would be equivalent, under present conditions, to a cut in price certainly nearer 20 per cent than 10, and we do not believe the stations are generally ready to stand for it. They can, however, pursue a middle course. There is some price at which the lamps could be supplied which would be equivalent neither to an increase nor to a reduction of price, but to holding the renewal factor practically unchanged. This would practically amount to furnishing renewals at some figure really slightly below cost so far as the lamps are concerned; a figure equivalent, so far as the station is concerned, to the old renewal costs and no more. Such an arrangement is certainly fair to everyone and gives a good opportunity for a sliding scale as the cost of the lamps decrease or their life increases. Ultimately the renewal factor or some of the new lamps may get down to the old basis, in which case free renewals will be in order. Until then, free renewals, if tried, mean simply a deliberate cut in price which may or may not be justified by the strategic conditions. That is a matter which every central-station man must judge for himself, but let no one be self-deceived in the matter. The new lamps are not yet down to standard form, life or cost. Many uncertain factors must be eliminated before one can fairly count up the average hours of life, and even then the moral hazard is hard to estimate. It is then a time for going slowly, for making no rash moves and, above all, for watching the performance of the lamps as they are kept in service. They cannot be kept track of too closely, especially with respect to blackening and breakage.

ELECTRIC HEATING.

About the only lesson conveyed by the usual discussion of the economics of electric heating is the utter futility of purely academic consideration of an intensely practical subject. It is, of course, true that electric heating is not in an ideal condition as regards economy. In fact, no one would be disposed to claim that at present prices, electrical energy for heating is prepared to go into general competition with fuel on the cost basis. On the other hand, even deliberately classing electric heating as a luxury is no argument against its use, and no augury against its popularity. It is altogether a mistake to suppose that things which pertain to personal comfort and convenience can be judged on a cost basis, however sordid and business-like may be the general tendencies of society. People buy articles, not because they are the cheapest that can be obtained to serve their purpose, but because they suit and please. Assuming that one is not forced to rigorous economy, he buys his winter overcoat not because it offers the maximum protection against cold per dollar of its price, but because he is pleased with its style, color and fit, and finds it sufficiently warm. Not all the statistics of the late Edward Atkinson could persuade mankind to feast on knuckle-bones and shins cooked to within the limit of possible mastication in his cele-

brated Swedish oven, so long as sirloin steaks and roast turkey could be had. The average American does not practise petty economy in his every-day living unless he is driven to it.

Thus it has come about that electric light, in the past confessedly dearer than gas light per candle-power-hour under ordinary conditions, has driven the latter out of general use save in cases where there is need for close economy. In the case of electric heating, people are quite willing to pay more than would be called for by other means of heating if they are thereby convenienced. At, say, 10 cents per kw-hour, electric heating is in general distinctly a luxury, but it is still one that people indulge in extensively as is made evident by the very large sales of the smaller electric heating appliances. As the price of energy is reduced more and more, heating devices come into use. At prices below, say, five cents per kw-hour, the great convenience of electric cooking on a considerable scale begins to outweigh considerations of cost, and at, say, three cents per unit, electric heating appliances for rooms would be widely used. In absolute cost even at these figures coal and gas would have perhaps the better of the argument, especially if they were as intelligently applied as is electricity; but it is convenience that counts, and the use of one heating means or the other is not strictly on the dollars and cents basis. The few central stations that have really made a careful study of electric heating find it a valuable addition to their income even if the price charged for current be very modest.

Without going into refined estimates, one finds that electrical heating devices in anything like their customary use will on the average add to the income of the central station at least their own cost yearly. So if such apparatus can be placed on the value of, say, $10,000, the gross station income will be $10,000 or more. This is not an amount to be neglected. At just what point electric heating costs become equal to the cost of heating by gas or coal is a matter of far less importance than the point at which people will cheerfully take up electric heating from preference. It is not necessary that big problems of heating should be taken up in order to get a big income for the station. It is the scores and hundreds of flatirons, chafing-dishes, little stoves, coffee urns, soldering irons, glue pots and the like that count in making the start in the electric heating business. Once under way the rest will look out for itself. When these small items are common, cooking ranges and portable air heaters begin to come along, together with a horde of heaters for use in the arts of which people seldom hear. When a deliberate attempt to get such business is made by offering whenever feasible a special rate for it, just as one does for motors, experience seems to show that business comes. But the price at which electric heat becomes, not cheaper than other forms, but freely salable as against them, is generally lower than the lighting rates, especially to the small consumer. This personage gets the short end of the bargain nearly everywhere, and consequently can be relied on to support the gas company which does not discriminate against him. And lighting by gas, he generally takes to cooking and heating by gas, and electric stations wonder why electric heating cannot be made to go with a rush. It will and does go with a rush when it is given a fair chance, and at a remunerative price. The big work in heating may come in due time, but the little work should be encouraged now.

Development in Alternating-Current Apparatus.

In alternating-current apparatus there have been several interesting developments during the past year. The split-pole synchronous converter is now so well known and thoroughly understood that it is difficult to realize that less than a year ago the possibilities of its operating successfully were questioned with evident sincerity by electrical engineers who had given considerable study to its characteristics. It will be recalled that this machine is arranged for delivering a variable direct e.m.f. at the commutator while a constant value of alternating e.m.f. is impressed upon the collector rings. The change in conversion-ratio is obtained by altering the distribution of the flux over the pole area. That such an alteration could produce the desired result has been recognized for many years, but a large majority of the designers of alternating-current machinery had been led to believe that, coincident with the change in flux distribution, circulating currents would be introduced into the alternating-current system. However, both theoretical considerations and practical tests have proved that the flux distribution may be altered in such a way as to produce the same effect as shifting the brushes on the commutator—without, however, involving sparking. Thus the direct e.m.f. can be varied throughout a certain range without causing complication in the alternating-current circuit.

The past year witnessed the commercial application of a new type of single-phase commutator motor possessing certain advantageous characteristics with reference to the suppression of sparking under running conditions. It would seem that this so-called series-repulsion motor can be so adjusted as to eliminate entirely the cause for trouble at the commutator throughout a very considerable range of speed. Its operation furnished evidence that the greatest disadvantages ever urged against the commutator type of alternating-current motor has been overcome so far as running conditions are concerned. However, the elimination of the cause for sparking in commutator motors under starting conditions remains as yet an unsolved problem. That the effects produced by the cause have been minimized to a thoroughly satisfactory degree by the use of preventive resistance leads is proved conclusively by the fact that motors thus equipped, after propelling locomotives in heavy railway service for more than 40,000 miles, show relatively little wear and are now in first-class condition. A record of this nature should go far in dispelling any doubt that may have existed concerning the ability of the single-phase commutator motor to meet the severe service requirements of steam railroad electrification.

A development which has been under way for several years, but which has been kept somewhat under cover until during the past year, relates to the substitution of "alloy steel" for "standard" steel in transformer cores. The newer core material, in which silicon appears as one of the chief "impurities," possesses two advantageous properties: it can be kept continuously at a high temperature without "aging," and—of even more importance—it experiences a much lower hysteresis loss than does "standard steel" operated at the same magnetic density and cyclic frequency; on the other hand, its permeability is slightly lower than that of older core material. On account of its non-aging property, the temperature at which transformers with silicon-steel cores may be operated is limited

by the temperature of destruction of the insulating material rather than by the core material. It is noteworthy in this connection that, while the A. I. E. E. rules limit the maximum temperature to 75 deg. C., German practice allows a maximum temperature of 90 deg. C. Assuming that insulating materials can be obtained to operate safely at a temperature of 85 deg. C., a permissible rise of 60 deg. C. above 25 deg. C. rather than a 50 deg. C. rise would allow an increase in rating of approximately 23 per cent. That is to say, a 10-kw transformer at a rise of 50 deg. can be rated at about 12.3 kw if allowed to operate at a 60-deg. rise. The increase here indicated would probably be considered excessive in the light of former practice, but transformer manufacturers have already shown an inclination to increase the permissible temperature rise in certain lines of transformers, thereby providing less expensive equipments for customers who are willing to replace transformers at certain intervals.

The lower specific energy loss in the alloy-steel when substituted for standard steel in transformer cores has been availed of by a large number of manufacturers. In order to take full advantage of this characteristic, it has been necessary to increase the operating magnetic density by a considerable percentage and consequently to increase the exciting volt-amperes by a much larger percentage. The last-mentioned increase is of no practical importance in transformers operated normally at relatively low density—that is, in high-frequency transformers—but it might become of some importance in low-frequency transformers. In any event, the alloy-steel can be directly substituted for standard steel without increasing the density or altering the exciting volt-amperes appreciably, but with a considerable decrease in the core loss. In addition to the improvements in constructive material for transformers, changes have been made in the arrangement of the coils and core of certain lines of transformers. Among the changes may be noted the use of a cross-shaped core for the magnetic path of the transformer. In this form a considerable part of the core surrounds the coils, while the coils surround a large part of the core, so that the old distinction between the "shell-type" and the "core-type" does not properly apply to this transformer. The transformer can be considered as one of the core type having coils on only one leg, the other leg being divided into four parts placed at 90 deg. intervals; it can also be treated as one of the shell type with two superposed paths in mechanical quadrature. In view of these considerations, it is more than probable that manufacturers who in the past have advocated the core type of construction will continue to refer to the new form as a core-type transformer, while the advocates of the shell-type will continue to claim that it is a development from the latter type of transformer.

ELECTROTECHNICAL PROGRESS DURING 1908.

The year 1908 has been marked by a distinct advance in the direction of controlling and operating high electrical pressures. Looking back upon the history of electrical progress and discovery, we may recognize that the eighteenth century was devoted to the study and development of high-tension electrical phenomena. The frictional machine was the generator, and the pressures employed were of the order of myriads of volts. Hardly any useful application was made from all of the knowledge thus acquired. The acquaintance with the world of electrical phenomena seemed to have begun at the wrong end—in the electrostatic region instead of in the electromagnetic region. Insulators and dielectrics were the order of those days. The study of conductors had to wait. The nineteenth century brought a great change. The voltaic battery supplanted the frictional machine, steady volts took the place of unsteady impulses by myriads. Soon the electromagnetic phenomena found utilization, first in electroplating, then in bell-ringing, next in wire telegraphy, afterward in electric lighting, electric telephony and electric power transmission. In these later applications pressures began to climb kilovolt by kilovolt. Already, in the early years of the twentieth century, electric power transmission is extensively practised at 60 kv, occasionally at 80 kv, while the pressure of 110 kv has been under successful trial. Again, after the lapse of a century, the insulator and the dielectric are becoming the predominating feature of electric transmission, as compared with the conductor and the metal. It would seem as though progress in this direction had to be arrested for a century in order to enable the practical difficulties to be outflanked.

During the last year, much technical progress has been made in the study of high-voltage phenomena, and much more achievement may be hoped for in this direction before long. The electrification of steam railroads has made distinct progress during the year, much attention having been directed to this field of future endeavor. It has come to be recognized that under present conditions economy does not lie in the electrification of every steam railroad. Nevertheless, it has been already demonstrated practically that certain conditions of railroad traffic can be operated not only more conveniently, safely, reliably and swiftly, but also more economically by electricity than by steam locomotives. Improved designs of electric traction motors have been developed, and the economic radius of electric railroad operation has been increased. The influence of this development of electrical engineering is likely to be manifested in all branches of engineering. Until electric power transmission attained considerable magnitude, mechanical engineers had but little necessity to become acquainted with electrical laws, devices and machinery. The electrical engineer, as a specialist, was able to take charge of electrical apparatus as it came into operation. With the rapid growth of power transmission, however, it became inevitable that, in future, all mechanical engineers should become acquainted with electrical machinery and systems, in order adequately to cope with the demands of their own profession. The rapid growth of electric railroading, on quondam steam lines, has left the matter completely determined beyond the peradventure of a demonstration. In future, no man can be fully trained in the professional needs and essentials of mechanical engineering who has not studied and become familiar with at least the elements of electrical science, systems and machines. Every mechanical engineer who is up to date will have to be more or less of an electrical engineer, and the barriers between these two branches of engineering have been destroyed. Per contra, every electrical engineer, who is up to date, must be familiar with the conditions of mechanical engineering.

Good advance has been made in wireless telegraphy and telephony all over the world, not only in applications, but also

in technical knowledge. Distances of several thousand miles have been covered in wireless telegraphy, and of several hundred miles in wireless telephony. Improvements have also been initiated both in Europe and America in wire telegraphy by which high-speed automatic telegraphy tends to take the place of low-speed hand telegraphy on important trunk lines. Two electrical exhibitions of importance were opened to the public during the year, one at Marseilles, and the other at Manchester, England. The public interest in such exhibitions is much greater than used to be evidenced at similar displays a decade ago. The public recognizes more and more that electricity is in every man's purview, and that electrical apparatus finds its way into most households.

Two electrical commissions were convened during the year in London under somewhat unfortunate condition as to dates, not being close enough together to be united, or remote enough to be distinct. The commission on electrical units adopted definitive values for the determination of the concrete international ohm and international ampere, as the fundamental units, leaving the volt, watt and other practical units to be derived from these two. The benefit to be expected from the work of this commission are not so much to be looked for in the details of the resolutions adopted, but in the implied adhesion of all the Government laboratories represented to one and the same manipulation, procedure, and set of concrete standards; whereby we may hope that the electrical units certified in each country may in future be consistent, and for all practical purposes identical each to each. The international electrotechnical commission council meeting was noteworthy, on the one hand by the absence of American participation, and on the other hand as evincing a spirit of earnest good will in laying the foundations for future international conventions in the direction of unifying the various national codes of rules for standardizing and rating electric machinery. The principal step taken to this end was the adoption of a resolution that all measurements referred to or designated in future by the commission shall be expressed in the metric system of weights and measures, as the official international system, non-metric countries contenting themselves with equivalents. Such action was in reality a foreseen conclusion, and no other basis of international electrical action would be conceivable, much less practicable, in view of the metric nature of electrical units. Nevertheless, since electrical engineering acquires each year more definitely the rôle of defining and maintaining all engineering magnitudes, this action of the commission means that eventually all engineering magnitudes must come to be expressed in metric terms. Thus, slowly do the burdens of tradition fall from the shoulders of modern engineering.

Telephony.

While it is often contended that the telephone industry is one of the national industries least subject to financial disturbances, in a retrospect of the past year telephony reflects strongly the general business conditions. On the construction side little has been undertaken in the way of new development, everyone being apparently content with the carrying to completion work already under way or actually needed for the protection of the existing service. The period has, however, not been an uneventful one owing to the great strides of the commercial branch. During the last decade the pressure of development was so great that telephone companies were glad to meet, at almost any cost, the demands of the public. There was no definitely accepted scheme of organization, each company meeting the situation presented as best it could. The recent period of "marking time" has, however, afforded a much needed respite, and as a consequence there has been a much-needed readjustment of organization. Companies have combined to reduce administration expense in some instances, or in others to warrant the more complete separation of various functions of operating work, each under the supervision of an expert. Operating expenses have been subjected to the closest scrutiny, and whenever compatible with good service, economies have been effected. There has been a marked improvement in the accounting departments of many of the smaller companies, especially among the Independents, who, largely through their associations, have been influenced to adopt uniform methods of accounting. The accounting relations with toll line companies have been largely changed by the central "clearing house" plan, now adopted in many localities and under careful consideration in others.

In territories where service is rendered by more than one company, the competing interests appear to be less mutually aggressive than in the past, the one becoming conscious of the unfairness of the low rates introduced by it because in many instances they are not living rates, and the other, in a measure at least, admitting the strength of competition. The net result is a movement toward an amicable solution of the dual service problem, through concessions of all three of the parties interested at first hand, the public being the third party. There is, however, a fourth element to be considered—namely, the toll line companies, for annulment of local competition throws the two existing systems of toll lines in direct competition on the merit basis. Apparently fearing the results of this, there has been a tendency in some localities for toll line companies to oppose any combination of the local services.

The long-distance toll-line system has now been extended as far as Denver, Col., and the importance of long-distance telephone service has been further evidenced by the opening of an underground cable toll line from Chicago to Milwaukee. This is, of course, "loaded" to maintain the transmission standard. There are now at least three of these underground toll lines of approximately 100 miles length each, and loading in general has been brought nearer to a standard. The repeater is also playing its part; while its successful operation is yet hemmed around by many awkward conditions, still it seems now only a matter of further knowledge of the controlling factors to bring it to a form adapted for general use. In the department of central-office equipment there has merely been a development along previously clearly indicated lines. The automatic switchboard has more than held its own, while the manual switchboard has slowly progressed toward the semi-automatic by the introduction more generally of automatic ringing and signaling devices. The semi-automatic class of exchange has also progressed encouragingly. The adaptability of the telephone for train dispatching was long ago made evident in interurban railway work, and its recent wide adoption by steam roads seriously affects the future position of railroad telegraph operators.

ELECTROCHEMISTRY IN 1909.

The development in the electrochemical and electrometallurgical industries during 1908 has not been along the radical lines which characterized the period of the establishment of the carborundum, artificial graphite and calcium carbide industries, but has rather been confined to progress along conservative lines. It is doubtless for this reason that few of the principal electrochemical industries of Niagara Falls were affected by the recent financial crisis. This is particularly true with respect to carborundum and artificial graphite, both of which products are finding an ever-increasing field of usefulness in multifarious industries. While the latest invention by Mr. E. G. Acheson in the production of "deflocculated graphite" has hardly any of the spectacular features inherent in some of his earlier discoveries, yet the invention appears to open for artificial graphite an almost unlimited field of application for lubrication purposes. The electrolytic processes of caustic soda and chlorine, chlorates, etc., have held their own very well, and the works using the Townsend cell in Niagara are making considerable enlargements. In the older chemical industries, electrochemical methods are also being more and more employed; but as the object in such cases is usually to make old and well-known products at less cost or of better quality, good care is generally taken to keep such developments secret.

The poor condition of the metal market, due to the financial and industrial crisis, has naturally greatly affected the related electrometallurgical industries. This was the case with the large electrolytic copper refineries of this country. After the enormous enlargement which they had undergone during the past few years, most of them were forced to operate during 1908 on a largely reduced scale. The greatest change, however, relates to the aluminum industry. After a long period of prosperity and steady prices the closing months of 1908 witnessed a slump in the price of aluminum, comparable with that of copper in 1907. How it came about is quite evident. Only a few years ago the existing aluminum companies—one in this country and five abroad—were hardly able to fill the demand, and all were forced to make very great enlargements. Concurrently, the fact that the aluminum process was no longer protected by patents in Europe attracted outsiders, and seven new companies started operation in Europe. Almost simultaneously came the financial crisis and the depression in the various industries, but especially in the automobile industry, resulting in a large reduction of the demand for aluminum. The supply was now much greater than the demand; the international syndicate could no longer control the market and was dissolved on Oct. 1. The price of aluminum in this country is now between 21 cents and 25 cents per pound, corresponding, on the basis of equal conductivity, to copper at 10½ cents to 12½ cents per pound. To the electrical industry as a consumer of aluminum the present situation certainly offers opportunities which should be carefully considered. In spite of the depression which has been prevalent in the iron and steel industries, the electric furnace for steel refining has made remarkable progress, though chiefly in Europe, but some remarks by Mr. C. M. Schwab at the recent tariff hearings in Washington indicate that the steel makers of this country are about ready to go ahead with electric steel refining. The electric furnace has already proved its superiority over the crucible process for making special steels, but its chief application will be as an accessory to existing open-hearth and Bessemer converter plants, to produce at a slightly enhanced cost a steel much superior in chemical composition and homogeneity. There are now in operation or course of erection 24 Héroult steel furnaces, 11 Stassano, 10 Kjellin, 10 Roechling-Rodenhauser, and 8 Girod, besides some smaller ones of other types. The aggregate charging capacity of the above furnaces (excepting five Héroult furnaces, the capacity of which has not yet been definitely decided) is 165,000 kg (181 tons). Two of the Héroult furnaces included in the above figures are in this country, all the others being in Europe. There are also several induction furnaces in use in this country, which are not included in the above figures as no exact data are available. It is probable that the most important development of electrometallurgy in the near future will be the general introduction of the electric furnace in the steel industry, not to supersede the existing furnaces, but as an accessory for further refining.

The quiet and conservative way of making steady and gradual advances and improvements which has lately characterized the electrochemical industry has finally brought us nearer to the full realization of the old fond dream of electrochemists—the fixation of atmospheric nitrogen. Technically, at least, the problem is solved, and even in two different ways, but commercial success still depends on exceptionally favorable local conditions, such as very cheap power. The one solution is the direct combination of the nitrogen and oxygen in atmospheric air by means of an electric spark or arc discharge. The advances made by Birkeland and Eyde over the older work of Bradley and Lovejoy are the use of larger furnace units, the employment of the arc instead of the spark discharge, and a very greatly simplified construction of apparatus, chiefly due to the use of a magnetically deflected, rapidly moving arc. Both capital investment and cost of operation have thereby been reduced. As a result of the commercial success, the Notodden plant is to be enlarged from a capacity of 40,000 kw to four or five times that figure. But this success must be interpreted with reference to the low cost of electric power at Notodden, which is reported to be only about $5 per hp-year. Nothing like this cost can at present be approached in this country. For some time it was thought that the results of Birkeland and Eyde came near perfection because they almost reached what is theoretically possible on the assumption that we have a purely thermal effect (the only function of the arc being to provide the necessary high temperature). It now seems that this hypothesis was wrong. If an arc is used in a somewhat lower temperature region, there seems to be added a specifically electric effect to the thermal effect, with correspondingly higher efficiency. This new development, which makes the situation appear much brighter, has been due to quiet work during many years of the Badische Anilin und Soda Fabrik. This process employs a very simple apparatus, an arc enclosed in a tube through which air is passed in whirling motion. An experimental plant of 2000 hp is stated to have been so successful that plans have been made for a 120,000-hp plant. The second and entirely different solution of the problem of fixation of atmospheric nitrogen is the manufacture of calcium cyanamide from calcium carbide and nitrogen. Cyanamide can be used either directly as a fertilizer or as a starting point for the manufacture of other chemicals, like cyanides. There are several cyanamide works in operation abroad and a large factory —the first one in this country—is now about to begin operation at Niagara Falls.

Disposal of the Heany Patent Fraud Case.

At Washington last week the Heany tungsten patent case, that has attracted so much attention on account of the allegations of fraud, was disposed of by the bringing in of a verdict of guilty against Everding, the patent attorney, and the acquittal of Heany, the inventor.

The specific charges in the criminal case related to two applications filed by Mr. John Allen Heany, one on Dec. 29, 1904, for a patent on certain "Improvements in the Manufacture of Filaments and Electrodes for Electric Incandescent and Arc Lamps," and the other on Jan. 19, 1905, which latter application resulted in the issue to Mr. Heany on Dec. 3, 1907, of United States Patent No. 872,936, for a "Tungsten Electric Incandescent Lamp." In both cases, Mr. Heany appointed Henry E. Everding, a patent lawyer of Philadelphia, his attorney to prosecute the applications, which were referred to Division 37 of the Patent Office and thereafter were examined by N. W. Barton, one of the assistant examiners in that division. When the patent of Dec. 3, 1907, was issued and the application thus made public, the disclosure therein of the development of practically the entire art of making tungsten filaments, almost to the date of issue, with the application date back in 1905, gave rise to such suspicion of its genuineness that a complete investigation of the whole file was made by the Patent Office itself. The evidence in this file was turned over to the Department of Justice, and the indictment followed. A subsequent investigation of the December, 1904, application brought to light other evidence in the specifications of that case too, and further indictments were found by the grand jury.

The indictments in the two cases were tried together and contained many different counts charging forgery, the destruction of public records and a conspiracy to defraud the United States. The persons charged as defendants were the lawyer, Everding, the Patent Office examiner, Barton, and the inventor, Heany. Before the trial began Barton withdrew his plea of not guilty and pleaded guilty to all counts of the indictments in both cases, and the trial proceeded against Heany and Everding. At the close of the Government's case, counsel for Heany moved that a verdict of not guilty be directed on the ground that a case had not been proved against his client, and the Court denied the motion on the ground that it was a question for the jury to decide. Heany offered no evidence, and the jury found that he was not guilty and not a party to the crimes charged. Everding practically admitted that he was guilty of all the charges made in connection with the application of January, 1905, which went to patent, but denied that he was guilty of any wrongful act in connection with the application of December, 1904, and claimed that the application in that case was in the same condition as when originally filed. Witnesses were called in support of the contention, and a direct issue raised between them and the witnesses of the Government. The Government was bound to satisfy the jury beyond a reasonable doubt that the wrongful acts charged were actually committed and by one or more of the defendants named; and the verdict of guilty was found against Everding on all counts of the indictments submitted.

The next steps by the Government are awaited with interest, in regard to the patent of 1905 and the application of 1904.

Large Power Trunk Line Transmission Under Way in New York State.

The Boston *Commercial*, a financial journal closely in touch with prominent electrical and copper interests, states that one of the most elaborate schemes of electrical development that has been thus far formulated east of the Rocky Mountains is now being slowly worked out through New York State and Michigan, with the plan of ultimately forming a trunk line system of electric transmission service from the Hudson River to Chicago. It is probable that from 5 to 10 years will pass before the plans are completely carried out. The companies concerned at the eastern end of the vast district under consideration are the Hudson River Electric Power Company, the Niagara, Lockport & Ontario Power Company and the Ontario Transmission Company. At the western end of the line the work is understood to be under the direction of W. A. Foote, of Grand Rapids.

The Hudson River company now supplies the Utica & Mohawk Valley electric traction interests with power, including the electrified West Shore Railroad between Utica and Syracuse, current being generated at the Hudson River. West of Syracuse the Niagara, Lockport & Ontario Power Company covers a field that includes every city, village and hamlet between Syracuse and Detroit. The power that is distributed by this organization is generated by the Ontario Power Company, of Niagara Falls, and the Niagara, Lockport & Ontario Power Company is in practically the same hands. The control of the Ontario Transmission Company is held by the Ontario Power Company, so that any construction work that may be necessary in Canada to carry out the several projects can be done by and in the name of the Canadian corporation. The Ontario Power Company has a plant on the Canadian side of the falls, designed to develop 200,000 hp when completed. The capacity of the generators now installed is 66,000 hp. This company is preparing plans for the construction of a penstock that will increase its capacity by 100 per cent, or to 132,000 hp. The obstacle of the Detroit River in transmitting power to the west is removed by the construction of a tunnel under the river by the Michigan Central Railroad, through which the line can be carried if desired.

South of Lake Erie the Niagara, Lockport & Ontario Power Company is building a transmission line to Erie, Pa., and has surveyed and mapped out a route for the main line into Cleveland. It is probable that the transmission of Niagara power will end at Cleveland, on account of the cost. West of Cleveland and from there to Chicago the cost of coal is low, tending to offset the advantages of hydro-electric transmission. It is probable that the line passing through Toledo, Elkhart, South Bend and Laporte will undoubtedly be supplied with steam generated current, with the coal from Ohio, Indiana and Illinois mines. A northern line from Detroit through Ann Arbor, Jackson, Battle Creek and Kalamazoo to Michigan City will be supplied with hydro-electric power from streams in the southern counties in Michigan. West of Michigan City steam power will be necessary. The conservation of resources and energy is the key to the work being done along the line from the Hudson to Chicago.

In New York State many thousands of dollars are being expended on water course investigations, and studies are being made concerning variations of flow and stream peculiarities. The water powers are passing into hands that will be able to assemble small amounts, and thereby secure a quantity of commercial value, while the owners will be able to a considerable extent to safeguard the supply of water in the rivers to which the smaller streams are tributary. Some of the power being used in Detroit is now being transmitted at low voltage from the eastern part of the State. An interesting phase of the problem is the location of trunk line railroads along the route of the proposed transmission trunk line, with a possible future bearing upon electrification.

Cambridge (Mass.) Electrical Department in Trouble.

The exhaustion of the appropriation for payment of salaries in the electrical department of the city of Cambridge, Mass., has caused considerable reduction in its working force. The city has been appealed to for an additional appropriation, but thus far without result. On Dec. 28 Mayor Wardwell notified the Council that an early consideration of the matter was necessary, calling attention to a letter from the electrical department commenting on the suspension of employees on account of lack of funds, and adding that the city electrician had

been instructed to keep enough men at work to afford the necessary protection to the lives and property of the citizens until the City Council shall have made the necessary appropriation. A new turn in the matter has been an order putting the fire-alarm telegraph system in charge of the fire chief, which reverts to a former arrangement.

Navy Long-Distance Wireless Plant.

On Jan. 5 proposals for furnishing long-distance wireless plants for the Navy will be opened, consisting of a sending station at Washington, having a range of 3000 miles, and two equipments for vessels having a receiving range of 3000 miles and a transmitting range of 1000 miles. The circular for prospective bidders is a formidable document which, if taken too seriously, might well deter any manufacturer from submitting a proposal. Aside from forms, there are 33 paragraphs, of which 31 consist mainly of conditions to secure the government from any possible loss, or exercise of any generosity toward a manufacturer who might, in his zeal to meet the need by the government for such a plant, too lightly pass over the difficulties incident to its design and construction—these precautions recalling the interesting game of "Heads I win, tails you lose." Apparently exhausted in the work of preparing these safeguards, the writer of the document confines to two paragraphs the specifications to guide the successful bidder, as follows:

"The station to be capable of transmitting messages at all times and at all seasons to a radius of 3000 miles in any navigable direction from Washington, D. C. Such messages must not be interrupted by atmospheric disturbances, or intentional or unintentional interference by neighboring stations. The station to be capable of transmitting and receiving messages with entire secrecy. The contractor must supply the necessary concrete buildings, with living accommodations for four operators, towers, ground connections, wiring and apparatus complete. Such to be erected at or near Washington, D. C., the exact location to be decided at a later date.

"Two sets of apparatus installed on board vessels of the United States Navy, to be capable of transmitting and receiving messages at all times, in all seasons and in all latitudes, to and from a distance of 1000 miles, and to receive messages from the high-powered station above-mentioned at a distance of 3000 miles at all times, the apparatus to be capable of transmitting and receiving messages at the maximum radius with entire secrecy and without the possibility of interruption due to atmospheric conditions or intentional or unintentional interference. These sets to include as an adjunct wireless telephone apparatus capable of establishing and maintaining satisfactory communication to a distance between ships of 100 miles. Such communication to be sustained without adjustment of instruments or interruption therefrom for periods of at least 5 minutes. This ship apparatus must be so constructed as to be installed in a room with 100 sq. ft. deck space. The antenna must be so disposed as not to require a change in the height or distance between masts or to materially change the outward appearance of the vessels."

System of Accounts Adopted by New York Commission.

The New York Public Service Commission, First District, has issued a classification of accounts for electrical corporations, to be introduced as of Jan. 1, 1909. The order accompanying the accounts for corporations with annual revenues in excess of $500,000 and the titles of the primary accounts are substantially uniform with those prescribed by the commission of the Second District and published in the ELECTRICAL WORLD of Dec. 12, 1908, page 1281. The commission of the First District has issued a supplementary order prescribing a condensed system of operating expense accounts for corporations with annual revenues not in excess of $500,000.

A report to the Commission of the First District by Commissioner Milo R. Maltbie, on the subject of uniform accounts, has been made public. Commissioner Maltbie constituted a committee which had in charge the preparation of uniform systems of accounts for the various classes of corporations under the jurisdiction of the commission. Mr. Maltbie states in the report that the committee has considered that the fundamental purposes of the law were: (1) To establish uniformity between all corporations of the same class. (2) To establish systems of accounts which will show clearly and accurately the specific source of all income and the purpose of every expenditure. (3) To state the fundamental principles according to which accounts shall be kept, so as to prevent the charging of items to wrong accounts.

In discussing the purpose to have accounts that will permit analysis of revenues and expenditures, Mr. Maltbie says that the public service corporations are using the property of the public and that the public is, therefore, in a sense a partner in the enterprise; that many corporations have a virtual monopoly and that experience with a policy of non-interference "has shown that the welfare of the individual, of the city and of the State is not adequately protected without regulation and control."

Mr. Maltbie discusses the relative points of view of the investor and the speculator in the securities of public service corporations. He declares that "an important reason for the general approval of highly differentiated forms of accounts is that they serve to protect and profit the thrifty and honest corporations. It is not the purpose of public regulation by reducing rates to take from a corporation all of the proceeds of enterprise and thrift that it may earn beyond a reasonable dividend. If a thrifty and intelligent corporation can, at a smaller expense to itself, supply a public service than a careless and incompetent corporation, the former should not be compelled to charge the public less than the latter. To do so is to discourage progress and economy. The systems of accounts reported will show what corporations exercise care, economy and ingenuity in operation and good judgment in the selection of employees. Present obscure and varying methods of keeping accounts furnish no basis of comparison, and a tendency is to put the thrifty and unthrifty in the same class and seek to deprive the stockholders of the thrifty corporation of their fair rewards."

In discussing the fundamental principles underlying the accounts, Commissioner Maltbie suggests the dangers of insufficient expenditures for maintenance, permitting the payment of dividends because no reserve is created for renewals, and of too large an expenditure on the plant from earnings.

Mr. Maltbie emphasizes the need of provision for depreciation and amortization in the accounts if the integrity of the capital investment and the correctness of the charges to "cost of operation" are to be insured. He says on the subject of depreciation:

"A true statement of expenses will include an allowance for the replacement of tangible and intangible capital, based on the most intelligent estimate that can be made of the probable life of such capital.

"In order that 'capital' may not be impaired, a corporation must provide not only for repairs and eventual replacement, but also for depreciation due to obsolescence and inadequacy. Cities are expanding and conditions are changing, so that occasionally certain portions of the physical property have to be reconstructed because the original plans have been outgrown or rendered useless thereby. Street railway tracks, for example, sometimes have to be moved to new streets because the direction of traffic has changed. Central stations or works are removed to new locations because urban growth has made their first locations undesirable and uneconomical. These changes often come very gradually and sometimes infrequently, but all expenditures for such purposes should be paid out of earnings and not out of capital."

The report refers also to the requirement that discount on securities issued shall not be considered a proper capital charge and to the stipulation that the account "franchises" shall be charged only with the amount "actually paid to the State or to a political subdivision thereof in return for the granting of

franchises or rights, exclusive of taxes or other annual charges."

Respecting appreciation, Commissioner Maltbie makes the following statement:

"It should be noted that the systems of accounts do not recognize appreciation in the value of property as an offset for depreciation. The policy adopted by many public service corporations of depending upon the increase in the value of their assets consequent upon community growth or changes in market values is not recognized as proper. Of course, ultimately the accounts will reflect these facts. If a piece of real estate is purchased for $100,000, if that amount is charged to capital, if it increases in value to $200,000 and it is found wise to sell it for that sum and purchase another piece of land equally suitable for $150,000, the ultimate result may be that 'land' will be represented in capital at an amount of $150,000 instead of $100,000; and that the surplus account will be increased by $100,000, which may be used as a reserve or distributed in dividends. The fundamental principle of the accounts, however, is that any appreciation shall not appear in the accounts until it is an actuality and until the amount of such appreciation has been determined by an actual sale of the property or the substitution of more expensive property. What shall be done when such a case arises is naturally a matter to come before the commission. It is not necessary in the systems of accounts to lay down a hard and fast rule."

New York Commission Prohibits Discrimination in Rates.

Following the completion of the investigation by the New York Public Service Commission, First District, for the purpose of determining whether an order should be issued "against discrimination and unreasonable preference by electrical corporations" a final order has been promulgated by the commission. The text of the order in full is as follows:

"Section 1. No electrical corporation shall directly or indirectly, by any special rate, rebate, drawback, or other device or method, charge, demand, collect or receive from any person or corporation a greater or less compensation for electricity or any service rendered or to be rendered, than it charges, demands, collects or receives from any other person or corporation for doing a like and contemporaneous service with respect thereto under the same or substantially similar circumstances or conditions.

"Section 2. No electrical corporation shall make or give any undue or unreasonable preference or advantage to any person or corporation, or to any locality, or to any particular description of service in any respect whatsoever; or subject any particular person or corporation or locality or any particular description of service to any prejudice or disadvantage in any respect whatsoever; but nothing in this section shall be construed as applicable to contracts with or service rendered to the City or State of New York.

"Section 3. No electrical corporation shall charge, demand, collect or receive a greater or less or different compensation for supplying electricity for light, heat or power, or for any service rendered, than the rates and charges applicable to such service as specified in its schedules filed with the Public Service Commission and posted and in effect at the time; nor shall any electrical corporation refund or remit in any manner or by any device any portion of the rates or charges so specified; nor extend to any person or corporation any privileges or facilities in connection with such service, except such as are regularly and uniformly extended to all persons and corporations under the same or substantially similar circumstances or conditions.

"Section 4. No electrical corporation, or any officer or agent thereof or any person acting for or employed by it, shall assist any person or corporation to obtain electricity for light, heat or power or to obtain any service at less than the rates then established and in force in accordance with the schedules filed with the Public Service Commission for the First District and published in accordance with the order of the said commission.

"Section 5. This order shall take effect at once and shall continue in force until abrogated or modified by the commission.

"Section 6. Every electrical corporation hereby affected shall notify the Public Service Commission for the First District, on or before Dec. 26, 1908, whether the terms of this order are accepted and will be obeyed."

Commissioner Milo R. Maltbie, who has had charge of the investigation, has made a report of progress to the commission on the subject of electric lighting contracts, rates, schedules, etc. It states that in respect to the form of retail lighting contract the companies had been urged (1) to simplify their form of contract, (2) to make it more like an application, (3) to standardize this form so that every company would be using the same form so far as possible, (4) to omit the minimum term of one year and allow the contract to be cancelled by either party upon a short notice, (5) to reduce to a minimum the regulations regarding the use of service and the relationship of the consumer to the company, and (6) to omit the requirement of a guarantee or the collection of a minimum charge in case the amount of current used by the consumer did not equal the guaranteed use.

All of these suggestions, with the exception of the last, were accepted, Commissioner Maltbie says, by all of the companies, and are now in operation. Five companies out of the nine under the jurisdiction of the commission have accepted the suggestion that guarantees and minimum charges be done away with.

Mr. Maltbie, in criticising the forms of wholesale contracts, states that the practice of offering a "rate or method of supply which will just bring to" the company, and no more, a certain class of business, "develops certain objections. The first is that under such conditions rates are likely to be valued upon the principle of charging what the traffic will bear and often without due regard to the cost of furnishing the service. This may lead, and does in some cases, to a fixing of price to certain consumers at a point below the cost of supply and to other consumers much above the cost of the service. Of course, in practically every private business, certain consumers are supplied at less than cost to some extent; but it becomes a serious matter when the number of rate schedules is large and each one is fixed at a point which will just secure the business. The second feature, which has been the cause of many complaints and of considerable annoyance, judging from the complaints made to the commission, is that a variety of contracts and schedules of rates makes it extremely difficult for many consumers to tell what form of contract or schedules would be most advantageous to them.

"These difficulties would be removed if the schedules were simplified and if one form of contract and one schedule of rates were in force. This was brought out in the investigation by the experience of the Westchester Lighting Company, which has but one contract for all power users. This contract contains a schedule of prices with a base rate of 10 cents. As the use increases, the discount from this base rate increases, so that a consumer who averages for a month 1.73 hours' daily use pays 9 cents per kw-hour for the current consumed. If he doubles his average daily use of his connected installations he pays 6 cents per kw-hour, and so on, with the result that the actual amount paid per kw-hour ranges from 10 cents to 4 cents, according to use. Under such a schedule the consumer pays in each month according to the use of that month, and is not confronted with the problem of changing his contract with every fluctuation in the amount of current consumed."

Mr. Maltbie concludes that it is "necessary that the forms of contracts should be as simple as possible, as few in number as possible and so adjusted that the actual amounts paid per kw-hour will gradually change from the highest rate for small consumption to the lowest rate for large users, while at the same time providing that every class of persons shall be charged an equitable amount and that every person in the same class shall pay at the same rate.

"The New York Edison Company and the United Electric Light & Power Company will put into force at the beginning of the year a new form of contract combining contracts

'Wholesale A' and 'Wholesale B.' This new form will remove some of the objections now existing and will lower certain rates, but it is not entirely satisfactory; there are certain objectionable features which must still be remedied."

In addition to the forms of contracts in general use Commissioner Maltbie takes up special contracts providing for special rates or containing special clauses. The vast majority of these contracts, he states, did not contain rates which differed substantially from the standard forms, the principal difference in most cases being in the form of a special order giving the consumer a privilege not generally given to others. In discussing this subject Commissioner Maltbie says:

"Opinions may differ as to whether the existence of contracts having such special clauses, not to be found in all contracts were applicable, produces discrimination and, therefore, renders such contracts voidable on the ground that they are discriminatory and in violation of the principle that all public service corporations must treat all consumers in a class equally. In my opinion such special provisions should not exist, except as between classes of consumers, and every person should be fully advised of all schedules of rates, forms of contracts, regulations as to supply and all other important terms, so that he may make his own selection of contract and not be forced or induced to adopt a system of bargaining or dickering in order to secure what some other consumer may have obtained by such means.

"Considerable discussion was given to this subject in the course of the investigation and at special hearings upon a proposed form of order. It will undoubtedly be beneficial to the companies and to the consumer to make public all forms of contracts, rates, etc., and to adhere to them strictly until experience shall have shown the necessity for a change, and then to make public all changes and to apply them to every one without exception. An order is transmitted herewith for adoption requiring all electrical corporations to file with the commission and post for public inspection schedules showing all rates of change, forms of contract and riders applicable thereto." This order, as adopted, is to take effect on Jan. 15, 1909.

"Besides the contracts with special clauses or riders the investigation developed," Commissioner Maltbie continues, "that six of the operating companies had contracts in force under which current was supplied at lower rates than to consumers generally." In discussing the reasons advanced by the companies in justification of certain rates, Commissioner Maltbie says:

"It may be open to question whether the practice of making experimental contracts with a few consumers is proper or improper, and probably this practice has not so far been abused, but it is possible of abuse and ought to be very carefully guarded if it is to be permitted in any case.

"As to the second class, it is true that a contract which a company will make with any applicant who meets the conditions cannot ordinarily be considered a discriminatory contract, unless the conditions which separate this class of consumers from others are unreasonable and without justification. In my opinion, the companies should be allowed considerable leeway in arranging their rates and in classifying their consumers, but there is a limit beyond which this cannot be carried without injustice, and the observations made in this report regarding general contracts apply with equal force here. The principal objection, however, to the few contracts of which I am now speaking is that the failure to make them public has prevented consumers generally from being aware of their existence, and probably has prevented persons from taking advantage of them who would have found it advantageous to do so, if they had known of their existence.

"The third class of contracts is, of course, purely discriminatory, and in violation of the principle of equal treatment. Such contracts ought not to exist, and it is probable that any consumer of that class who does not have the special rates could go into court and make it impossible for the company to collect the higher rate called for in his contract. Fortunately, the number of these contracts is not large and has been steadily decreasing during recent years. In fact, many contracts that were in force when the commission was created have since been voluntarily cancelled by the companies; others are now being cancelled, and it is probable that within a few weeks they will have been eliminated entirely."

The conclusion reached by Mr. Maltbie is that "conditions have greatly improved within the last decade. The principle is more and more being recognized that all terms and conditions of supply should be public, that equality of treatment should everywhere apply, and that methods and practices should be standardized so that each consumer will be on an equal footing with every other consumer in the same class."

Progress of Radio-Telephony.

BY LEE DE FOREST.

While the installation of radio-telephone apparatus on 26 ships of the United States Navy, prior to their "Round-the-World" cruise, demonstrated the great utility of wireless telephone communication for inter-fleet work, it also demonstrated the necessity for making this apparatus more nearly automatic, to put it into the hands of unskilled operators, or whoever wished to use the instruments.

Lessons were learned from these installations which no amount of theory or laboratory experiment could have taught. Following upon reports of the engineers who went with the fleet to Trinidad, the aforementioned improvements were developed and were installed upon the fleet when it arrived at San Francisco, and on its way to Honolulu. Reports from the latter point as well as those received from Western Australia indicate that the radio-telephone service has been rendered much more efficient by these automatic adjuncts.

About the same time the improved apparatus was demonstrated before the French Government at the Eiffel Tower station. Using the small antenna similar to those on shipboard, voice communication was maintained from Paris to Melun, 60 km (36 miles), and later at Marseilles, 130 km (80 miles). During two nights, when the high antenna on the Eiffel Tower was in use, it was reported by the French Government wireless operator at the Mediterranean station near Marseilles, that gramophone music was heard over that distance, approximately 550 miles.

Following these demonstrations in Paris, the French naval officers, especially Lieutenants Colin and Mercedier, continued experimenting with apparatus which they built following the De Forest designs, and have since reported very satisfactory results from Eiffel Tower to Dieppe, 150 km (93 miles).

The Italian Government purchased four sets of radio-telephone apparatus for marine work, which the writer installed at Spezia last May.

The apparatus has been still further improved during the last summer, and in September, at the request of the British Admiralty, an official demonstration was made between H. M. S. *Furious* and *Vernon* at Portsmouth, England. During these tests perfectly clear and accurate voice communication was maintained up to a distance of 60 English miles, although this was by no means the limit attainable with these instruments on shipboard. As a test of accuracy during these tests, long lists of numerals were read into the transmitter on board the *Furious* and written down at the receiving station on the *Vernon*. A comparison of these figures, e.g., at the distance of 44 miles, shows an accuracy of 98 per cent.

Further development and refinement has progressed since the Admiralty installation. The apparatus is being continually simplified and its range increased, so that it is now fair to say that the radio-telephone is to-day applicable to a large number of vessels which cannot afford to carry a Morse operator, and which will be content with 100-mile communication.

Significant of large development in the near future is the fact that a contract has been made with the Metropolitan Life Insurance Company for the use of its new tower (680 ft. high) as a wireless telephone and telegraph station. This will give the tallest antenna of the world, except that at Eifel Tower, and it is reasonable to expect some long distance records from this station during the coming year.

A. I. E. E. Veterans.

A correspondent has sent the following list of present members of the American Institute of Electrical Engineers of 20 years or more standing—that is, of those still retaining their membership in that body who joined within the first five years of its life, or from 1884 to the end of 1888. Associate members are designated by (A):

1884.

A. G. Bell, Washington.
C. F. Brush, Cleveland.
C. L. Buckingham (A), New York.
C. R. Cross, Boston.
E. N. Dickerson (A), New York.
Philip Diehl, Elizabeth, N. J.
C. A. Doremus (A), New York.
G. F. Durant (A), New York.
T. A. Edison, Orange, N. J.
S. D. Field, Stockbridge, Mass.
G. A. Hamilton, New York.
E. J. Houston, Philadelphia.
F. W. Jones, New York.
T. D. Lockwood, Boston.
C. O. Mailloux, New York.
T. C. Martin (A), New York.
G. C. Maynard, Washington.
J. F. Morrison (A), Baltimore.
J. C. Reilly (A), Brooklyn.
Elihu Thomson, Lynn, Mass.
T. N. Vail (A), New York.
W. B. Vansize, New York.
Edw. Weston, Waverly Park, N. J.
Joseph Wetzler, London, Eng.
Charles Williams (A), E. Somerville, Mass.

1885.

Adams Bosch, Newark, N. J.
C. L. Clarke, New York.
Leo Daft, Rutherford, N. J.
John Millis, U. S. Army.
R. W. Pope (A), New York.
E. P. Roberts, Cleveland.
T. A. W. Shock (A), York, Pa.
S. S. Wheeler, New York.

1886.

Samuel Insull (A), Chicago.
A. R. Ledoux (A), New York.

1887.

Thomas Ahearn, Ottawa, Can.
E. M. Barton (A), Chicago.
E. G. Bernard, Troy, N. Y.
C. S. Bradley, New York.
P. T. Brady (A), New York.
J. S. Brown, New York.
C. A. Coffin (A), New York.
G. H. Condict, New York.
Louis Duncan, New York.
R. N. Dyer, New York.
F. R. Fielding (A), Virginia City, Neb.
H. A. Foster, New York.
W. J. Hammer, New York.
H. McL. Harding (A), New York.
F. B. Herzog, New York.
E. E. Higgins, New York.
H. F. R. Hubrecht, Amsterdam, Holland.
C. J. R. Humphrey (A), New York.
R. M. Hunter, Philadelphia.
F. E. Idell (A), New York.
W. J. Jenks, New York.
W. P. Judson (A), Oswego, New York.
E. R. Knowles, Brooklyn.
H. W. Leonard, New York.
E. L. Nichols, Ithaca, N. Y.
R. J. Nunn (A), Savannah, Ga.
J. W. Lieb, New York.
S. B. Paine, Boston, Mass.
I. F. Porter, Davenport, Ia.
R. J. Pratt, Honolulu.
E. E. Ries, New York.
Almon Robinson (A), Lewiston, Me.
F. W. Roebling (A), Trenton, N. J.
L. W. Serrell (A), New York.
C. F. Sise (A), Montreal, Can.
G. H. Stockbridge (A), New York.
C. A. Terry, New York.
Ernest Thurnauer, Paris, France.
W. D. Weaver, New York.
E. R. Weeks, Kansas City, Mo.
F. R. Welles (A), Paris, France.
H. M. Whitney (A), Boston.
A. E. Winchester, New York.
E. L. Zalinski (A), New York.

1888.

E. G. Acheson, Niagara Falls.
H. W. Blake (A), New York.
W. E. Case (A), Auburn, N. Y.
Lewis Dearing (A), Denver, Col.
Carl Hering, Philadelphia.
J. W. Howell, Harrison, N. J.
A. A. Knudson, New York.
P. A. Lange, Manchester, Eng.
John Langton, New York.
W. D. Marks, New York.
C. W. Parks, U. S. Navy.
Frederick Reckenzaum, New York.
E. W. Rice, Jr., Schenectady, N. Y.
A. L. Rohrer, Schenectady, N. Y.
Sir D. L. Salomons, London, Eng.
Frederick Saxelby (A), New York.
Nikola Tesla (A), New York.
H. C. Townsend (A), New York.
W. S. Turner, New York.
Montgomery Waddell, New York.
Leonard Waldo, New York.
C. J. Wharton, London, Eng.
W. H. Wiley (A), New York.
Fremont Wilson, New York.

The founding of the Institute in the spring of 1884 was immediately due to the International Electrical Exhibition held later that year in Philadelphia, which was expected to have a considerable attendance of foreign electricians. In consequence, it was felt that there should be some national electrical organization to co-operate with the exhibition authorities in the reception or entertainment of distinguished visitors and lend aid in organizing and carrying out any professional work that might come forward in connection with the exhibition. At a preliminary meeting held April 15, with Dr. N. S. Keith in the chair, the details of organization of the proposed body were placed with a committee consisting of Messrs. N. S. Keith, Geo. A. Hamilton, W. A. Hovey, Wm. H. Eckert and Geo. L. Beetle. The committee reported at a meeting held May 13 in the rooms of the American Society of Civil Engineers, when the plan of organization submitted was adopted and the following officers were, upon its recommendation, elected: President, Dr. Norvin Green; vice-presidents, Messrs. A. G. Bell, C. D. Cross, T. A. Edison, G. A. Hamilton, C. H. Haskins and Frank L. Pope; managers, Messrs. C. F. Brush, W. H. Eckert, S. D. Field, Elisha Gray, E. J. Houston, C. L. Hilling, F. W. Jones, G. B. Prescott, W. W. Smith, W. P. Trowbridge, T. N. Vail and Edward Weston; treasurer, R. R. Hazard; secretary, N. S. Keith.

The total membership of the Institute 20 years ago was 350, of which number 125 were full members. In 1900 the corresponding figures were 1183 and 374 respectively. At present the total membership is 6091, of which 592 are full members.

Patent Treaty with Germany.

The terms of a treaty between the United States and Germany relating to patents has been agreed upon, and it is stated that the completed treaty will soon be brought before the U. S. Senate. According to newspaper statements, the treaty was negotiated by Patent Commissioner E. B. Moore, and has for its object reprisal on Great Britain owing to its recent action in requiring the actual working in Great Britain of patents granted to foreigners.

Electric Signs for Chicago Elevated Railway.

Mr. F. J. Gurnsey, superintendent for the Loop Managers' Association, Chicago, Ill., has announced that he is planning on installing large illuminated electric signs on all of the elevated railroad stations located on the loop of the Chicago Elevated Railways. According to his plans, a large sign reading "Elevated Stations" will be installed on the elevated structure at the principal street corners. Numerous smaller signs, reading "To All Trains," will be installed at the entrances to the elevated stations. Mr. Gurnsey's plans also include the additional installation of a large number of incandescent lamps on the platforms and in the waiting rooms of all elevated stations. Mr. Millard B. Hereley, city traction expert, is working with Mr. Gurnsey to bring about these improvements.

Association of Edison Purchasing Agents.

The fifth regular meeting of the Association of Edison Purchasing Agents was held at Buffalo, N. Y., on Dec. 18, 1908. Included in the transaction of business was the election of officers for the ensuing year. The only change in the personnel of the officers was the election of Mr. C. A. Harding to succeed the late Mr. R. C. P. Holmes. The present officers are: Mr. H. F. Frasse, president, purchasing agent, Edison Electric Illuminating Company of Brooklyn; Mr. C. A. Harding, vice-president, chief clerk, purchasing department, Commonwealth Edison Company, Chicago, Ill.; Mr. H. C. Lucas, second vice-president, purchasing agent, Philadelphia Electric Company; Mr. James B. Eaton, treasurer, purchasing agent, Rochester Railway & Light Company; Mr. Andrew Banks, Jr., stock controller, purchasing agent, Consolidated Gas Electric Light Company, of Baltimore; Mr. J. W. Brennan, secretary, purchasing agent, The Edison Illuminating Company, Detroit, Mich.

The next regular meeting of the association will be held at the same time and place as the convention of the National Electric Light Association as provided for in the by-laws.

Water Power for Denver Light & Power Systems.

The Denver Gas & Electric Company officials and those of the Central Colorado Power Company have come to an agreement under which the Denver Gas & Electric Company is to use energy supplied from the water-power plants of the Central Colorado Power Company. At first the steam plant in Denver will be operated as before until the reliability of the long-distance transmission lines which cross several mountain ranges has been established. The Central Colorado Power Company has under construction a mammoth water-power development and system of transmission lines. Its first power plant will be at Glenwood on the Grand River. Another which is under way is near Boulder, about 20 miles from Denver. The company has already nearly finished many miles of very heavy transmission line on steel towers, and has water-power rights for enough power to supply the whole State of Colorado. The enterprise has been the subject of considerable interest, not only on account of the heavy engineering features, but because of the speculation as to where the market for so much power would be found. The company has done a large amount of

construction work without any large contracts for its use. This agreement with the Denver Gas & Electric Company will take a considerable percentage of the output from the first development.

American Water-Power Resources.

Dr. M. J. McGee, secretary of the Inland Waterways Commission, presented some interesting statistics in the report of that commission read at the recent Joint Conservation Conference at Washington. The total rainfall, including snow and that on water areas, was given as 215,000,000,000,000 cu. ft. a year. Half or more is evaporated. About one-third flows into the sea. The remaining one-sixth is either consumed or absorbed. Of the 70,000,000,000,000 cu. ft. flowing annually into the sea less than 5 per cent is used for power. It is estimated that 85 per cent to 95 per cent of the volume is wasted in freshets or destructive floods. There are in mainland United States 232 streams navigated for an aggregate of 26,115 miles, and as much more is navigable by improvement. The theoretical power of the streams is over 230,000,000 hp. The amount now in use is 525,000 hp. The amount available, according to this report, at a cost comparable with that of steam installation, is estimated at 37,000,000 hp; and the amount available at reasonable cost is placed at 75,000,000 hp to 150,000,000 hp.

The estimate is made that the inland waterways of the country could be improved in 10 years at a cost of $50,000,000 annually with such results that there would be a saving in transportation annually of $250,000,000; an annual saving in flood damage of $150,000,000; an annual average saving in forest fires of $25,000,000; an annual benefit in cheaper power of fully $75,000,000, and an annual saving in soil erosion benefiting farm production.

"It is estimated that the income derived from power developed by works for the improvement of navigation would alone, at current market rates, utilize in cooperation with States and citizens, compensate the entire cost of maintenance and continued development after the initial expenditure of $500,000,000 as a working capital."

Electricity at the Sportsmen's Show, Boston.

One of the noteworthy features of the Sportsmen's Show now being held in the Mechanics Building, Boston, is a novel wireless telegraph exhibit under the auspices of the Acme Wireless Construction Company of Cambridge, Mass. The apparatus is mounted in a log cabin, and is designed along lines shown to be most satisfactory for woodland service. Equipment of this type is now guaranteed to operate successfully over distances of about 30 miles in the woods and from 60 to 150 miles in the clear. The wave length used is about 1500 meters.

The equipment consists in the main of a transmitting helix with adjuster for tuning the helix and antenna to the desired wave length, a transmitting key designed to carry the current necessary to operate the equipment, a power plant consisting of a 2½-hp gasoline engine and a 110-volt, 15-amp generator specially designed for close regulation under inductive load, a loosely coupled receiver, transformer and aerial. All this apparatus is portable and the largest piece carried separately weighs only 50 lb. The aerial consists of from 5 wires up, suspended horizontally above the ground at a height of from 80 to 100 ft., and about 80 ft. long, deadened on each side to trees. The wire preferred for this service is No. 12 rubber-covered. The voltage at the base of the antenna averages from 40,000 to 60,000. This set is specially designed for use in summer homes and camps situated on islands remote from the mainland, and in locations where the laying of a cable or the erection and maintenance of an overhead line would be out of the question. The cost of a set of this type is about $600. Maximum selectivity and immunity from interference are secured by the loosely coupled receiver. Smaller apparatus for amateur use was also exhibited. Similar equipment has been used successfully on the battleships of the Atlantic fleet, and in U. S. Navy Yards.

Rules for Wires Crossing Railroads in Iowa.

The rules adopted by the Railroad Commissioners of Iowa for wires crossing railroads are the result of a conference at which electric light, railway, telegraph and telephone companies were represented. The order requires that all poles sustaining wires which cross railroad tracks shall be of sound timber, cedar or better, with not less than 6-in. tops where more than two wires are carried, and not less than 5-in. tops in any case, and placed in the ground to a depth of not less than 5 ft., well tamped, braced and guyed if necessary, of sufficient height so that the wires shall not be less than 24 ft. above the top of the rails, after allowing for sag. The cross arms shall be braced with iron braces, and locust hedge or steel pins shall be used. Pin guards shall be attached to the ends of all cross arms where crossing poles are not in a straight line with the pole on either side. Crossing poles shall be braced or head-guyed, and such poles, braces or guys may be placed on the railroad company's right of way lands, but must not interfere with the safe operation of the railroad.

In line construction poles shall not be set further apart than 115 ft. at railroad crossings and in no case shall crossing poles be set nearer than 10 ft. from the nearest rail of the main line track, and shall be provided with double cross arms to be placed upon the poles in a gain of sufficient depth to maintain the cross arms at right angles to the poles.

In all cases where any wire-using company shall desire to place its wires under the tracks of any railroad company, it shall, at least five days before so doing, serve a written notice upon the agent of the railroad company at the station nearest to the place where such crossing is to be made. The wires, cables or conduits used in such crossings shall be placed at least 3 ft. below the bottom of the rails of the track.

The foregoing rules do not apply to the feed or trolley wires of an electric railway, but such wires shall be placed at least 22 ft. above the tops of the rails of any railway crossed thereby. They shall be carried on or supported from sound cedar trolley poles with not less than 7-in. tops, or suitable iron trolley poles of sufficient height and strength.

Whenever the wires of any telephone or telegraph company or other persons, firm or corporation making use of aerial wires shall cross the right of way of any railroad company where the wires of either company are subjected to 700 volts or more, safety appliances shall be installed and maintained at the expense of the company desiring the crossing, which shall furnish adequate protection against the danger to life and property incident to contact between the wires of the companies in question. The form of the protection may be determined by the companies interested by mutual agreement, and in the event of their disagreement, shall be determined by the Board of Railroad Commissioners.

Where it is impracticable to use poles at railroad crossings on account of buildings, cross-arm fixtures must be attached to the building with machine bolts passing through the wall. The use of screws or nails for fastening fixtures to buildings will not be allowed.

Where reconstruction of wire-carrying lines is made necessary to make them conform to these regulations, the expense of such reconstruction shall be borne by the party last occupying the ground where such reconstruction is made necessary, and each party shall make all reconstruction on its own lines, unless by mutual agreement.

In special cases where compliance with the above and foregoing rules would work a hardship upon any company in extending its wires over or under any railroad, or of any railroad company extending its railroad across the line of any wire-using company, application may be made to the board to make such order for crossing as deemed reasonable and just.

The above and foregoing rules and regulations shall be in full force and effect from and after this date, as to all new construction, and all persons, firms or corporations, are required to change existing construction at crossings so as to comply with the foregoing rules by Jan. 1, 1909.

CURRENT NEWS AND NOTES.

ZINC SMELTING PLANT.—The Canada Zinc Company, Nelson, B. C., has started the first of its furnaces for the reduction of zinc ores by electricity.

BRITISH TELEGRAPHS.—The returns for the British governmental telegraph and telephone services for the year ended March 31, 1908, show a deficit of $4,145,654, an increase of $1,017,965.

P. R. R. TUBES READY FOR ELECTRICAL EQUIPMENT.—The contractors for the P. R. R. tunnels under the North River, New York, have about finished their part of the work, and the four tubes will be turned over in a few weeks for the electrical equipment.

PANAMA CANAL ELECTRIC LIGHTING.—A 400-kw steam-driven generator has been installed at the Empire power plant, Canal Zone, which will furnish electric light to the district between Gorgona and La Boca. The district between Gorgona and Matachin continues to be lighted from the Gorgona power house.

EARTHQUAKES IN MONTANA.—Advices from Montana state that Virginia City has recently experienced some 30 earthquakes, and that one on Dec. 27 put the electric plant out of commission and interrupted the lighting service. The disturbances coincided with severe earthquakes in Southern Italy. The lighting plant at Virginia City is about 10 miles from town.

BRITISH POSTOFFICE WIRELESS.—The first postoffice wireles station in England was opened by Postmaster-General Buxton on Dec. 11. The station is situated at Bolthead, on the Devonshire coast, and is intended primarily for communication with ships at sea. Mr. Buxton, in a speech at the opening, intimated that a series of similar offices would be scattered throughout the United Kingdom.

ILLUMINATING ENGINEERING SOCIETY.—The annual meeting and election of the Illuminating Engineering Society will be held on Friday, Jan. 8, at 8 p. m., at the Machinery Club, New York City, preceded by dinner at 6 p.m. It seems unfortunate that this meeting should coincide with that of the Electrical Engineers, at which Prof. Elihu Thomson discusses one of the aspects of illumination.

A. I. E. E. MEETING.—The next regular meeting of the American Institute of Electrical Engineers will be held in the Auditorium of the Engineering Societies Building, 33 West Thirty-ninth Street, New York City, on Friday, Jan. 8, 1909, at 8 p. m. Prof. Elihu Thomson, of the General Electric Company, West Lynn, Mass., will present a paper entitled "Conditions Affecting Stability in Electric Lighting Circuits."

AMERICAN ROENTGEN RAY SOCIETY.—This body is holding its ninth annual convention in New York this week. The meetings are being held in the Academy of Medicine and the exhibit of apparatus, etc., is made in the Engineering Societies Building. Dr. E. W. Caldwell, of New York, is president, and Dr. G. C. Fulton, Pittsburgh, secretary. The members are all interested in the electro-therapeutic uses of the ray.

CONCRETE POLES.—The Pennsylvania R. R. Co. has placed in experimental service at New Brighton, Pa., a line of reinforced concrete 30-ft. telegraph poles tapering from 14 in. at the butt to 6 in. at the top. Several years ago the same company set 53 reinforced concrete line poles near Maples, Ind., which have been giving excellent satisfaction. Importance is attached to the increased strength of the new poles, which withstand the strain of the line, even on curves, without any bracing.

CHICAGO CENTRAL-STATION interests are getting together in a geographical sense. The North Shore Electric Company, which does the electric light and power business in the suburban area around Chicago, has moved its headquarters from the Chamber of Commerce to the tenth floor of the Home Insurance Building, 205 La Salle Street. This building adjoins the Edison Building, 139 Adams Street, which is the main office of the Commonwealth Edison Company. The two companies are operated on a friendly basis, and Mr. Samuel Insull is president of both.

MOVING PICTURE SHOWS.—A commotion was caused in New York last week by the sudden prohibition issued by Mayor McClellan of all moving picture shows. This left the 10-cent shows in operation under a different form of license from the police commissioner. The cheaper shows have been attacked as often immoral and often given in dangerous places, where fire would be disastrous. It is stated that 500 such places of all kinds exist in New York, representing an investment of $50,000,000, with 12,000 employees. A great many of them are users of electricity, and their moving picture requirements are extensive. The proprietors of the shows have organized for protection and to secure more liberal treatment.

DAMS ACROSS NAVIGABLE STREAMS.—The subcommittee of the House Committee on Interstate and Foreign Commerce, to which the matter was referred, has reported in favor of amending present laws so that the Secretary of War may fix charges for the privilege of constructing a dam. It will make an alternative recommendation that this money either be devoted to restoring conditions of navigation to the original state before the dam was constructed or be turned into the treasury, to be applied to the improvement of navigation generally. The subcommittee also has accepted the recommendation of the President that there be a specific time limitation on permits and has fixed 99 years as the limit, but did not favor his proposition to levy a tax on the power used.

GERMAN TROLLEYS.—U. S. Consul-General Richard Guenther, of Frankfort, says that while the steam railroads of Germany have had a considerable reduction in their earnings since the middle of last year, as they are largely depending upon freight traffic, the tramway companies show increased gains. Thus 53 of the latter companies, whose income is derived almost totally from passenger traffic in the cities, during the fiscal year 1907-8 earned 9 per cent clear on their combined share capital of $77,911,000, whereas their net earnings in the preceding year figured at 8 per cent. Seven of the tramway companies paid no dividends, 46 paid their stockholders from 2 per cent to 10 per cent, and three companies declared a 10 per cent dividend. The trolley lines in the smaller cities do not work very profitably.

POWER IN BRAZIL.—At the recent Conservation Conference in Washington, Ambassador Nabuco, of Brazil, spoke of the immense resources belonging to the Southern Republic in the rivers Amazon and Sao Francisco and said: "The present century, I hope, will see that immense canalization all ploughed by steam and electricity. When the connection of the Amazon with the sources of the River Plate, to which we supply nearly the whole of its waters, will be established, the earth will see an inland water system of a magnitude never dreamed before. I think we ought to be proud of those immense prospects of river and forest combined, by the side of powerful falls, destined to supply all the electricity we may need. With that vision of the future I do not like to speak of our rivers as they appear to-day. Take the Sao Francisco. The men of science who have been on its banks agree that the Sao Francisco is a great river of the future and that the central region it drains will show one day immense wealth. I think it is a good thing for a nation to have a part of its assets under lock, kept for a time of greater progress all round, both in agricultural sciences, in metallurgy and in electricity."

Quarry Street Station of the Commonwealth Edison Company, Chicago.

BY WILLIAM KEILY.

SUCCESS in the central-station business depends primarily, of course, on the kind of men who are engaged in it. Good men are required—men who are hard-headed but broad-minded, far-seeing yet prudent, boldly imaginative in planning for the business of the future without being visionary, enthusiastic and inciting enthusiasm in others, yet at all times sensible, judicious, "safe and sane." Such men have discovered that two considerations are of vital importance—reducing the cost of production to the lowest point by scientific engineering and disposing of the output in large quantities at low price by scientific salesmanship. It is well to bear these two closely related principles in mind, for the application of them in Chicago has resulted in the building of the Quarry Street generating station of the Commonwealth Edison Company. This plant, just placed in operation, has a present equipment rated at 28,000 kw and is designed for an ultimate equipment of 84,000 kw. It is the purpose of this article to describe briefly the physical characteristics of this unusually important station, but a valuable lesson would be overlooked if the significance of its creation were not pointed out.

The president of the Commonwealth Company declared not long ago that to-day in cities of the first rank the central-station industry has come to be a vast manufacturing business, and he pointed out that if the electric-supply companies are to maintain their positions they must go more and more into the wholesaling of energy to large users, such as street-railway companies, elevated-railway companies, and possibly later on to the larger transportation companies of the country.

As Mr. Insull has shown, there is probably no other business benefited more in the way of reduced cost of production by increased amount of output. These two factors are correlated and mutually beneficial. They have been greatly stimulated by the introduction of the steam turbine, which is especially conducive to the economical production of electric energy in very large quantities, both from the viewpoint of capital expenditure and operating cost.

Following the policy here outlined, taking prompt advantage of modern engineering development in power-house design and applying the advanced ideas of modern salesmanship the Com-

FIG. 1.—TURBINE ROOM IN QUARRY STREET STATION OF COMMONWEALTH EDISON COMPANY.

monwealth Edison Company has been conspicuously successful, as of course is well known to everybody in the electrical industry. Its annual report for the year ended Sept. 30, 1908, showed gross earnings of $9,500,000 and net earnings of $3,125,000. The capital stock is $30,000,000. There are four large generating stations and 33 substations. On the date mentioned the company's commercial business amounted to the equivalent of 4,137,650 16-cp lamps connected. But, in addition, the company is supplying electrical power amounting approximately to

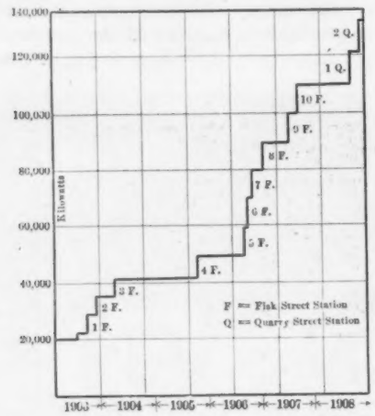


FIG. 2.—DIAGRAM SHOWING INCREASE IN GENERATOR EQUIPMENT.

75,000 hp, under contracts running from 5 to 10 years, to street railways and other public-service corporations which have found it to their interest to purchase power.

The new Quarry Street station, with its present rating of 28,000 kw in two units, is practically devoted to generating energy for railway load. Fisk Street station, the pioneer steam-turbine power house of this country, was put into operation in 1903 and proved to be remarkably economical in cost of energy production, and particularly so in the case of the later units. It has now 10 turbo-generators, with a rating of about 100,000 kw. This station efficiency permitted the company to go after wholesale business at prices which were astonishingly

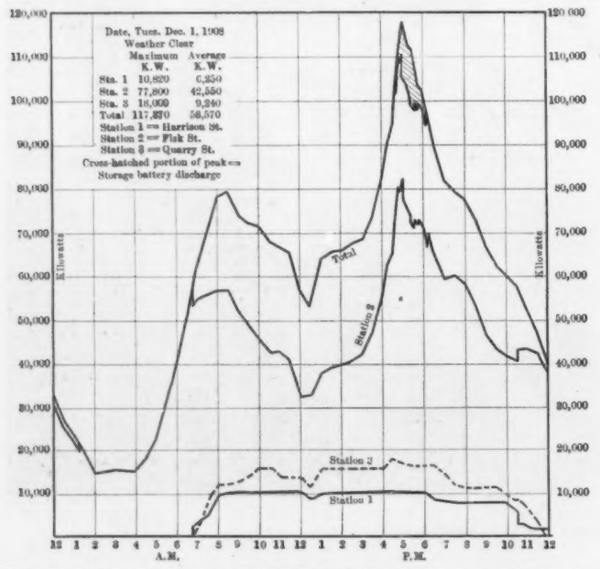


FIG. 3.—LOAD DIAGRAM SHOWING PROPORTION OF LOAD CARRIED BY DIFFERENT STATIONS.

low. In one railway contract the energy-consumption charge runs as low as 0.4 cent a kw-hour, but there is also a "minimum primary charge" of $15 per maximum kilowatt per year and the rate is based on a probable demand of 40,000 kw, a 10-year period and an exclusive contract. The connected load grew very rapidly, and although the Fisk Street station is completed to only three-fourths of its ultimate rating, work was begun last year on an entirely distinct generating station, just across the river from Fisk Street, on Quarry Street. It was decided to create an entirely new plant to add to the factor of safety in reliability of operation.

The accompanying diagrams show the rapid increase in generator equipment and also the load curves for Dec. 1, 1908. The total load is shown to have reached over 117,000 kw. One of the curves shows the proportion of railway load and also the growth in total business in five years. The other load diagram shows the proportion of the load of Dec. 1 carried by

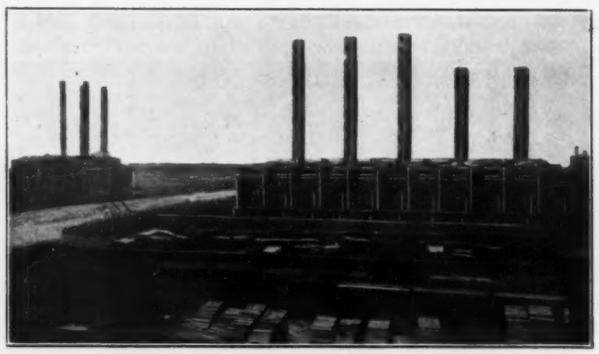


FIG. 4.—VIEW OF FISK AND QUARRY STREET STATIONS.

the three generating stations in use on that day. In this curve the cross-hatched peak is the storage battery discharge. Ordinarily the battery is used only for standby service, but on this particular day the load was unexpectedly heavy, and the batteries were discharged to assist the generating stations as indicated.

What has been said heretofore is intended to point out the reason for the existence of the Quarry Street station. No attempt will be made to describe the complete generating, transmission and distributing system of the Commonwealth Edison Company. That was done in a comprehensive article in the Electrical World of May 16, 1908. Since then the new station has been put into service, although still unfinished, and a

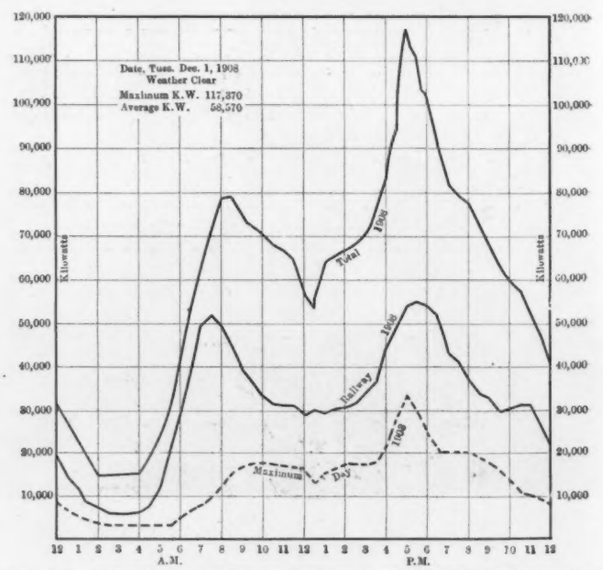


FIG. 5.—LOAD DIAGRAM SHOWING TOTAL LOAD, RAILWAY LOAD AND LOAD IN 1903.

general outline description of it is now attempted. However, in relation to the system as a whole, it may be of interest to point out that, in conjunction with the North Shore Electric Company, which is in friendly hands, it supplies energy from Waukegan, Ill., south to Kankakee, Ill., a distance of about 100 miles. North of Waukegan one of the transmission systems extends 50 miles farther to Milwaukee, so that the ex-

treme range of application of energy generated in these steam-driven stations is 150 miles.

GENERAL CHARACTERISTICS OF THE QUARRY STREET STATION.

The Fisk Street station lies on the south branch of the Chicago River, about three miles southwest of the center of the central business district in a straight line. The new Quarry Street station has been built on land secured by the company directly across the river, which here has an east-and-west direction. A ferry service is maintained. The two stations are quite distinct; a breakdown in one would not affect the other; nevertheless they are operated together—that is, there is one chief engineer for the two, and the station force of 350 hands can be shifted from one to the other as needed. Thus the two great stations mutually support each other.

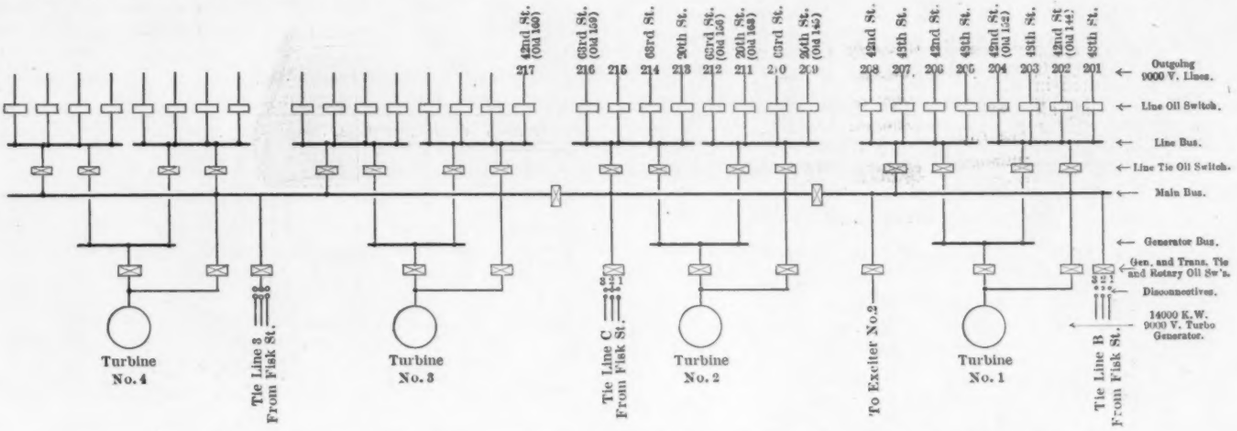


FIG. 6.—ELECTRICAL CONNECTIONS SHOWING ARRANGEMENT OF UNITS OF SWITCHING EQUIPMENT.

The general layout of the Quarry Street station differs somewhat from that of the Fisk Street station. This is due principally to real-estate limitations. Owing to the narrower site the boilers are in two parallel rows instead of the equipment for each unit extending at right angles to the turbine room as at Fisk Street. For the same reason the switch house is included in the station building instead of being a separate structure as at the older station. Although the Fisk Street station has a record of steam consumption of 12.94 lb. per kw-hour, nevertheless it is expected that the efficiency of the new station as a whole will be better than that of its more imposing neighbor.

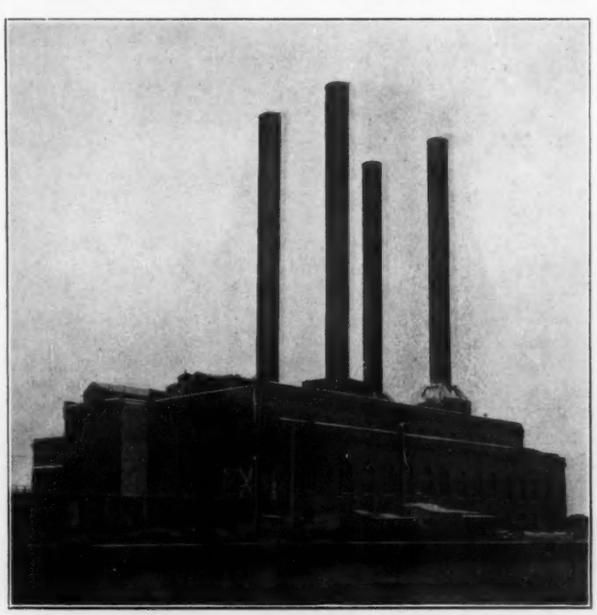


FIG. 7.—QUARRY STREET STATION FROM RIVER.

Completed as planned, the building will be 463 ft. long and 208 ft. wide. The portion now built is a little over half of this, or about 270 ft. long and of the width mentioned. The station comprises four sections, separated by fire walls, and extending longitudinally the whole length of the building. These are the train shed, on the north side, where the coal cars are received, next the boiler room, then the turbine room, while the switch house forms the southern section. In the southwest corner is the Quarry Street substation, while various offices, lavatories, test rooms and the like are provided. Elaborate provisions for welfare work for the men are not needed, owing to the proximity of the Fisk Street station.

The finished station is designed for six 14,000-kw turbo-alternators. Two of these are now in service. The present building will hold another unit, but extensions will be required for any additional units. The piling is in, however, for the complete building.

Architecturally, the building is dignified, yet less ornate than the Fisk Street station. This is in accord with the engineering design, which, for so large a plant, is comparatively simple and compact. However, the building is thoroughly well and substantially constructed. The exterior, of the red pressed brick which the Commonwealth Edison Company long ago adopted as standard, is imposing; the interior is pleasing and spacious, with very excellent provisions for light and air. The turbine room, in particular, at present 268 ft. long, 56 ft. wide and over 60 ft. high, impresses one by its size; it contains the largest prime movers in the world in point of rating, but they do not look large in it. This is partly due to the fact that while they are large they are not relatively so considering their great output.

FIG. 8.—VIEW OF BOILER ROOM.

Natural light in abundance is admitted by skylights, monitors and side windows. Over the turbine room there is one large central monitor, and there are also two-part windows in the southern outside wall above the switch house, which, like the

train shed, is not as high as the rest of the building. The opening of these windows is effected from the floor of the turbine room by compressed air.

The operating room or gallery is in the switch house, but extends through into the turbine room with a curved glass front. It will be in the center of the southern wall of the turbine room when completed and about 35 ft. above the floor. From this point the operator can survey not only the generating units, but also the accessories, such as boiler-feed pumps, oil pumps, oil filters, etc., which are not placed in a dark corner of the boiler room, as is sometimes the case. The turbine room is finished in white enameled brick. There is a visitors' gallery running along the north wall, and another interesting feature is a permanent railroad track extending for the whole length of the building between the row of turbines in the center and the south wall of the room.

DISTINCTIVE ENGINEERING FEATURES.

It seems fair to say that the Quarry Street station embodies the very latest advances in electric power-house design. The dominant idea, of course, has been to secure the greatest attainable economy of operation, combined with safety and reliability of operation. To this end the plant seems to represent distinct progress in the art in the following particulars:

1. Size of the units, which are rated at 14,000 kw. These machines are not only the largest dynamo-electric machines now in operation anywhere, but it is believed that the turbines are the largest prime movers in use for any purpose. Possibly there are marine engines larger than these individual units of 18,500 hp, but, if so, the writer has not heard of them.

2. The ventilation of these very large units is entirely new. The generators may be operated at their maximum output without overheating.

3. The degree of vacuum obtainable in winter is probably the best known in the art, being 98 per cent of the absolute zero of pressure.

4. By a boiler setting new to central-station power-house design practically smokeless combustion is secured.

5. The plant will require a minimum of labor.

6. A split-pole rotary converter is installed in the substation in this power house. It is the first machine of its type.

7. Electrical connections in the switch house are compact and comparatively simple, with several new features, including specially designed disconnector switches at the base of the oil switches which add much to the safety of operation.

8. It is believed that the station represents the lowest cost of maximum output yet attained in this country. A superior record of economy in operation is hoped for—even better than that of Fisk Street.

STEAM GENERATION.

Coal is brought into the station in cars run on the two tracks in the train shed. Here it is dumped into hoppers emptying into a longitudinal McCaslin conveyor and taken to a crusher at the western end of the train shed. Transverse conveyors transport the fuel to bunkers over the boilers holding 150 tons for each individual boiler. The ash conveyor presents no novel features; it is similar to that at Fisk Street.

Arranged in two rows parallel to the turbine room are eight water-tube Babcock & Wilcox boilers for each unit, or 16 at present. Each boiler has 5000 sq. ft. of heating surface, exclusive of the superheating surface. The boilers are designed for 225-lb. gage pressure and for a maximum steaming capacity of 35,000 lb. per hour. The superheater is designed to give from 150 to 175 deg. Fahr. of super-temperature when the boiler is operated at 30,000 lb. of steam per hour. The automatic chain-grate stokers are 8.5 ft. x 11.5 ft.

The boiler setting represents a new departure in power-house design adapted from recent marine practice. The furnace is placed under what is ordinarily the rear header of the boiler. This arrangement makes a somewhat higher setting than usual, but it enables a great improvement to be made in boiler efficiency. It embodies the idea of a long flame chamber expanding in volume to aid combustion as opposed to the

FIG. 9.—INTERCONNECTED TRANSMISSION SYSTEMS OF COMMONWEALTH EDISON AND NORTH SHORE ELECTRIC COMPANY.

old practice of a short flame chamber and contraction in volume, which prevented complete combustion. In consequence of this arrangement objectionable smoke will not be produced, even though the boiler with its furnace be driven to the maximum capacity of the latter. Owing to the greatly increased size of the combustion chamber, complete combustion is obtained before the hot gases come in contact with the heating surfaces of the boiler. Thus, the operation of the plant is practically smokeless, while the efficiency of the boiler is increased and there is a distinct advance in economical working.

Four steel stacks 12 ft. in inside diameter and extending 250 ft. above the boiler-room floor are provided for the present equipment. In the boiler room is a hand-power 5-ton Whiting crane.

TURBINES AND TURBINE-ROOM EQUIPMENT.

The central feature of the ultimate Quarry Street station as planned will be the row of six 14,000-kw turbo-alternators. The two now in use are placed on the center line of the turbine room. They consist of five-stage Curtis steam turbines direct-coupled by means of a vertical shaft to General Electric 9000-volt, three-phase, 25-cycle, four-pole, revolving-field generators. The speed of operation is 750 r.p.m., and the units are rated at 14,000 kw on the new maximum continuous rating; that is, for 24-hour service. The machines stand about 27 ft. above the floor. Including the condensers in the basement, the entire height of each unit is 33 ft. 4 in., while the diameter is 14 ft. 8 in. The turbines are placed in right-and-left order, or back to back. Two units constitute a set, and between them are placed the auxiliaries. Thus Unit No. 1 and Unit No. 2 are much farther apart than are Nos. 2 and 3; the average distance apart is less than might be supposed from considering the placing of one set alone.

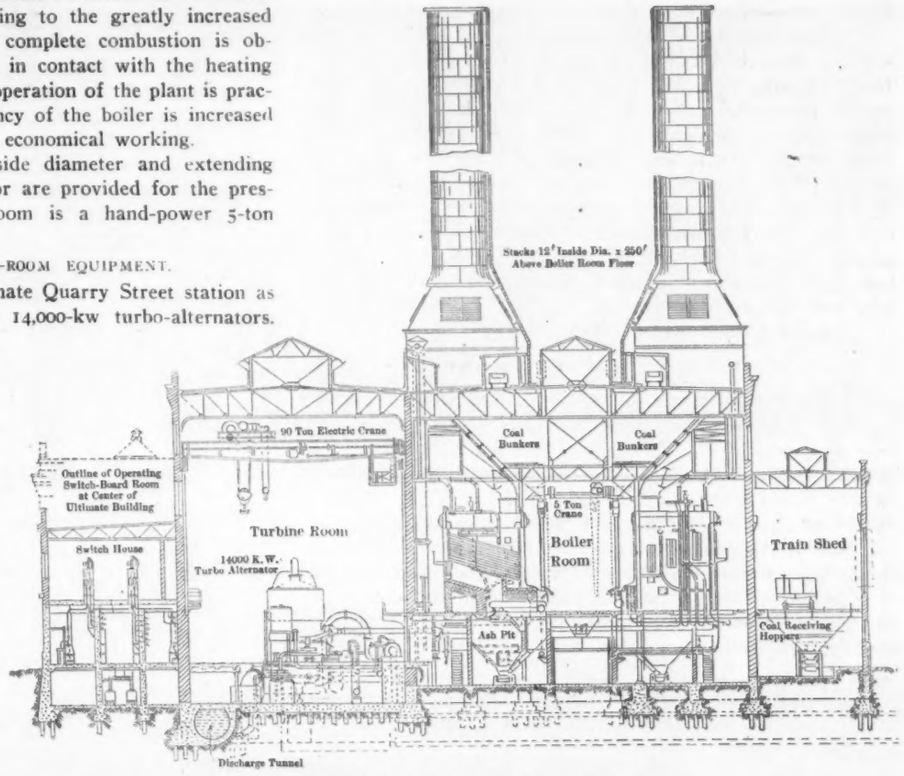


FIG. 11.—CROSS-SECTIONAL VIEW OF STATION.

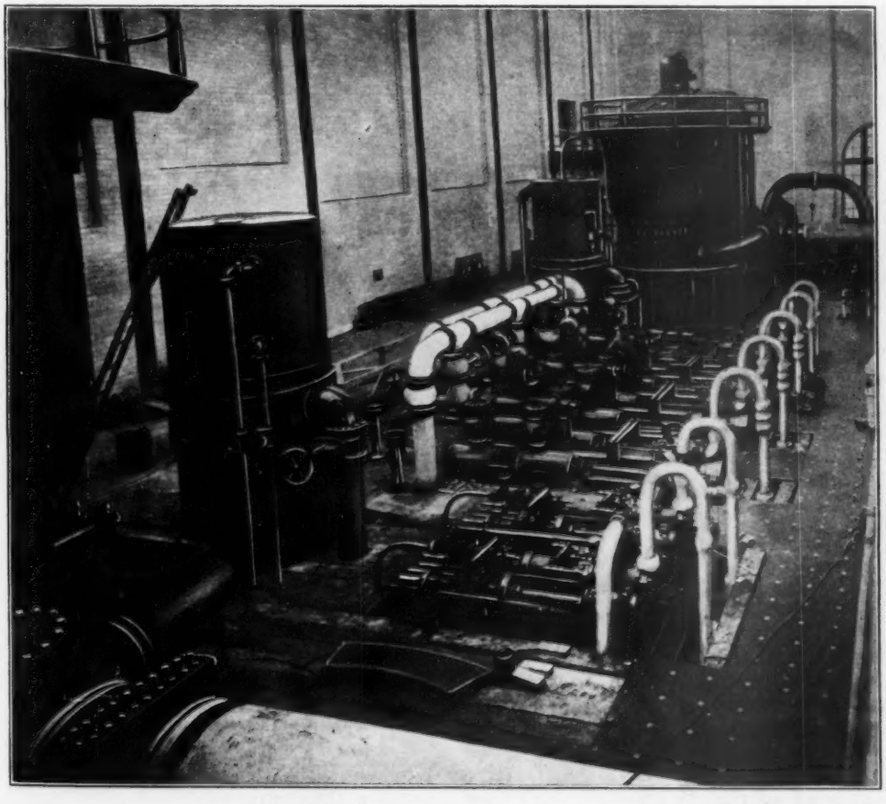
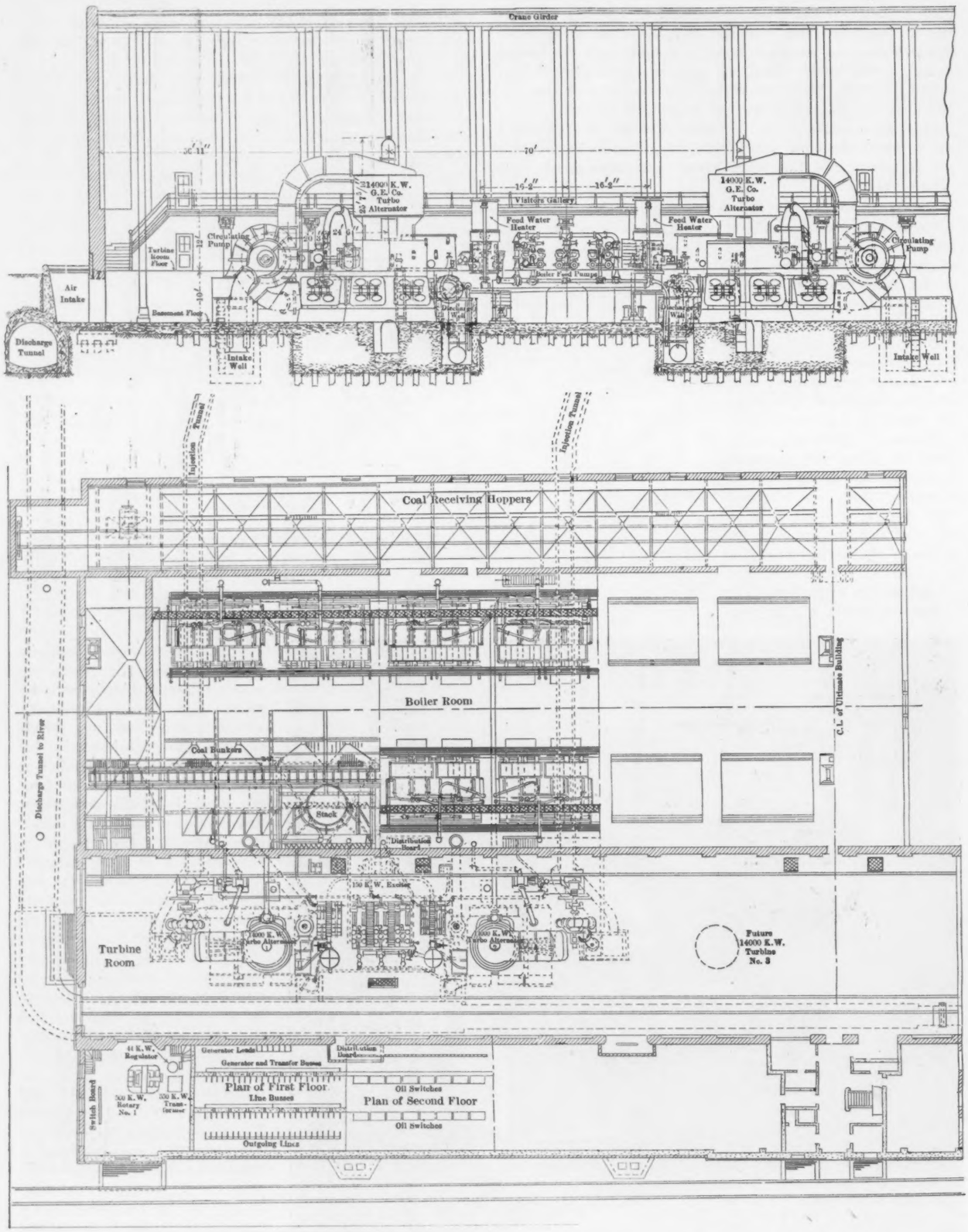


FIG. 10.—VIEW OF TURBINE ROOM SHOWING AUXILIARY APPARATUS BETWEEN UNITS.

From their output standpoint the machines do not impress one as so very large. This is partly because with these enormous revolving masses on an upright shaft the center of gravity has been kept as low as possible to lessen vibration. The condensers, particularly, are designed to take up space horizontally rather than vertically. They are in the basement and partially extended out—two-thirds under the respective turbines and one-third to the right or left under the space used on the floor above for auxiliaries. This is a new and important development, for it contributes greatly to the absolute steadiness of running which is so greatly desired. Each condenser has 25,000 sq. ft. of surface.

Another very important and novel feature is the means adopted to secure ventilation of the generator. Heretofore it has been difficult, with the ordinary power-house construction, to provide the ventilation necessary to allow the large turbine units to operate at their most efficient outputs. The Quarry Street station has been designed with this point continuously in view. In the basement is a specially constructed air chamber connected with the out-

side air. A great elliptical air duct equal in area to a circle over 6 ft. in diameter, which leads from this chamber to the top of the turbo-generator, is a very conspicuous feature of the machine; it catches one's eye the moment he enters the room. Vanes are placed on the encased revolving field core, which thus acts as a gigantic fan and pulls air through the duct, thoroughly ventilating all parts of the machine. The heated air is blown out through the laminations of the stationary armature and rises to the top of the turbine room, where are the noticeably numerous window openings already described, the usefulness of which is now doubly apparent. This arrangement necessarily takes up a good



FIGS. 12 AND 13.—ELEVATION OF TURBINE ROOM AND PLAN VIEW OF QUARRY STREET STATION.

deal of space, but it is simple, automatic and very effective.

In the main shaft, between the turbine and the generator, is inserted a flexible friction coupling which normally transmits the load unaffected. It is intended, however, in emergency, as in case of a short-circuit or the machine getting out of phase,

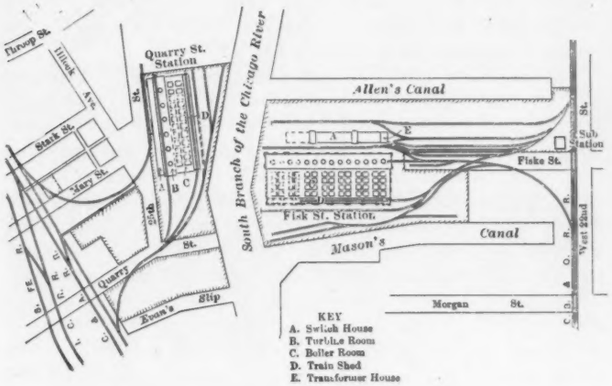


FIG. 14.—PROPERTY PLAN OF FISK AND QUARRY STREET STATIONS.

to be the part that will yield to the stress, thereby protecting the unit from serious injury. This is another new feature, tried for the first time in the Quarry Street station.

Space will permit of only a cursory reference to the turbine auxiliaries, which are, however, very carefully planned to obtain the great ends—economy, safety and reliability. Everything is in duplicate, so that the chance of breakdown is remote. There are two volute circulating pumps, each driven by a 125-hp Corliss engine. The water of condensation is re-

FIG. 15.—NEAR VIEW OF 14,000-KW TURBO-GENERATOR.

moved from the condensers by two rotary pumps driven by Kerr steam turbines. For each two units of turbines and boilers three horizontal boiler feed pumps are provided, located between the turbines, as stated. There are also four step-bearing oil pumps, two oil accumulators, dry-air pumps, oil filters, etc. All are in plain view of the turbine-room operating force.

Excitation of the main generators has been most carefully provided. For the six ultimate units five 150-kw exciters will be installed, three driven by horizontal Curtis steam turbines

FIG. 16.—OIL SWITCH COMPARTMENTS.

and two by 25-cycle, 220-volt induction motors. One of each of these types is included in the equipment of the present plant. In addition there is an excitation storage battery of 70 cells in the basement. Furthermore, in an emergency the split-pole rotary converter of the substation could be used for excitation.

Two switchboards are placed on the turbine-room floor.

FIG. 17.—VIEW OF BUSBAR COMPARTMENTS.

One is for the exciters and consists of three panels, the middle one for the storage battery. A feature is that all of the motor-operated rheostats are placed on top of the board in plain view. The other board is for the distribution of energy for the local 115-230-volt Edison three-wire, direct-current service. Here also is an additional safeguard, for this board is inter-

connected with the Twenty-second Street substation across the river by two 1,000,000-circ. mil feeders.

Spanning the turbine room is a Whiting traveling crane with a lifting capacity of 90 tons. It is equipped with four motors.

The six leads from each of the generators are in tile ducts cemented in. They follow the under side of the air duct down to the basement and continue to the switch house adjoining.

Mention may be made here of the fact that the total lift of the water supply of the circulating system has been very carefully minimized, so that the static head imposed on the system may be as small as possible. Apparently no chance to effect a little economy in operation has been overlooked. There is a common discharge tunnel for circulating water for the whole station. In the completed station there will be four intake tunnels, two for two units each and two for one unit each.

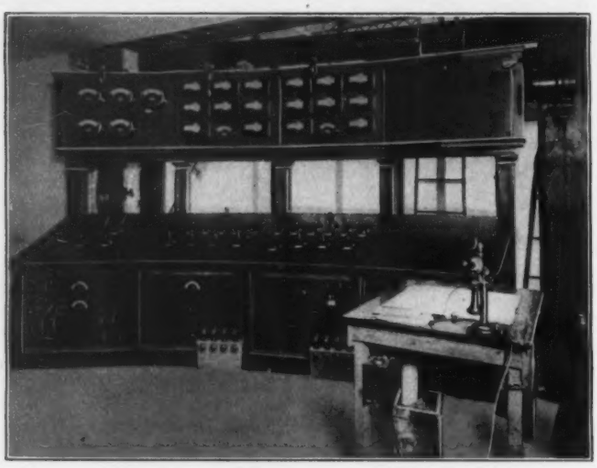


FIG. 18.—SWITCHBOARD IN OPERATING GALLERY.

SWITCHING APPARATUS.

The switch house forms the southern portion of the building, but is not as high as the main section containing the boiler and turbine rooms. It has two stories and basement, with the addition of a third story in the longitudinal center of the ultimate building for the operating switchboard room. The second story contains the high-tension oil switches, while the busbars and other high-tension connections, together with the instrument transformers, are located on the first floor. Low-tension and high-tension cable runs are placed in the basement, where there is ample room.

Four 9000-volt units of switch equipment, each with eight transmission lines, are accommodated in the present switch house, while the arrangement is such that 20,000-volt bus and switch equipment may be installed in the future without difficulty should the development so require. Provision is made to operate all units in parallel or separately with certain units at the Fisk Street station, which is ordinarily done by means of two tie lines, each capable of transmitting at least 12,000 kw.

The basement and the first floor are divided for their entire length into three chambers, but the second floor contains all of the oil switches for four switching units in one room. The oil switches are arranged in two rows, the north row serving as group or tie switches between the generator, transfer and line buses, and the south row for the outgoing high-tension transmission lines exclusively. Eight switches are built together in each row to insure stability and economize space. Fig. 16 gives a view of the oil switch compartments and shows the arrangement of the switches in two rows.

Simplicity in design characterizes the high-tension buses and their connections and compartments. All buses run east and west only, and are arranged in vertical position, each conductor being confined to a special fireproof compartment and supported on porcelain insulators. All busbar barriers and shelving are made of "Elecrete," a new form of concrete designed for electrical use. All copper bars and rods, properly insulated, are separated by barriers, and the instrument transformers are likewise contained in Elecrete compartments with special cabinets for fuses within easy reach. These cabinets are provided with doors of asbestos board. A view of the busbar compartments is given in Fig. 17.

The generator leads for each phase, consisting of 1,000,000-circ. mil lead-covered cables, after leaving the series transformers, are taken to the generator and transfer bus oil switches, enabling energy to be furnished to the feeders of any switching unit. The transfer bus is located above the generator bus on the same wall and runs throughout all switching units, sectionalized at certain points by means of oil switches, while the generator bus is individual for each unit. The line buses are two in number for each switching unit, with four transmission lines connected to each bus. A special Elecrete wall for supporting series instrument transformers and terminal bells on the eight outgoing lines is built along the south wall of the switch house. It has also the necessary compartments for the shunt-instrument transformers. In order that any of these transformers may be easily replaced, all of them are set on the floor.

A distinctive feature in the design of the high-tension bus chamber is the straight, forward connection from the bells of the generator leads to the bells of the outgoing transmission lines. Great precaution has been taken to minimize the danger to life and property from the manipulation of the high-potential circuits. For instance, all oil switches are equipped with self-locking and self-unlocking disconnective switches, in order to "kill" either switches, buses or connections in case of cleaning or repairing. These disconnective switches were specially designed for the Quarry Street station, and add a valuable element of safety. Again, a signal board is provided in the oil-switch room. It has a number of signal lamps connected to shunt-instrument transformers of the generator leads and to high-tension lines. This indicates, from an outside source, whether any of these lines are "alive" before any disconnection of oil switches is done. In the design of all switching apparatus the element of safety has been considered of paramount importance.

In the basement of the switch house the south chamber is provided with two bays where the ducts from the street enter from the transmission lines. A steel structure, with several trays, has been built, and it facilitates the drawing in and connecting of any new line. All present lines leave the station in three-conductor, 250,000-circ. mil.

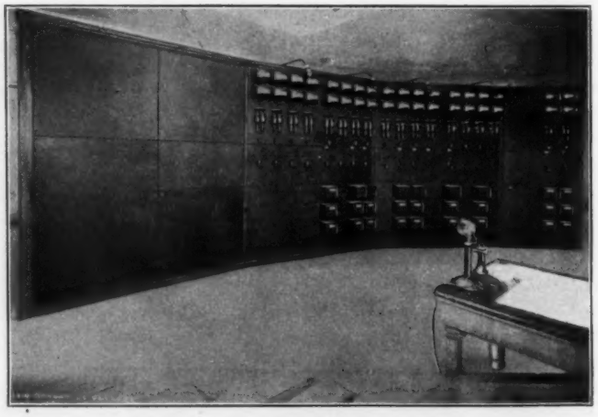


FIG. 19.—SWITCHBOARD FOR OUTGOING LINES.

OPERATION AND CONTROL.

All instruments and control wiring consists of single conductors grouped in fiber conduits from the terminal boards in the high-tension bus chambers and in iron conduits from the oil-

switch room to the operating room. The series and shunt leads for the instruments are also grouped in separate fiber conduits. A special room running along the north wall of the oil-switch room is reserved to take care of terminal boards and conduits for the four switching units. In this room all conduits are exposed, whereas all pipes in floors and high-tension compartments are concealed.

The operating room, on the third floor of the switch house, but also opening into the turbine room, contains all switchboards for the operation of all generators and lines. Machine control and line control are effected on two distinct boards ar-

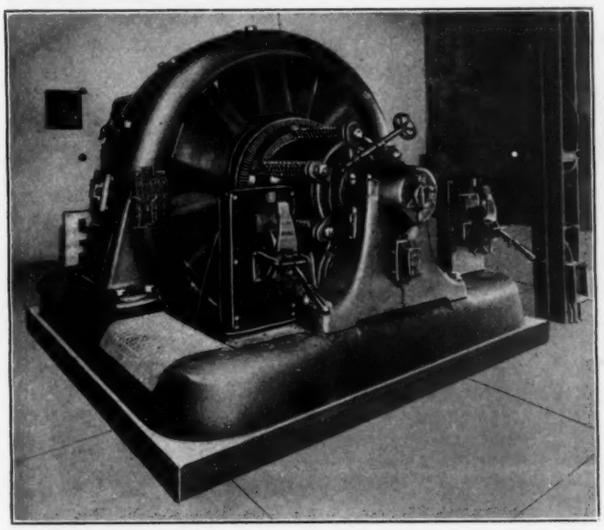


FIG. 20.—SPLIT-POLE ROTARY IN SUBSTATION.

ranged in curving form and nearly opposite each other. This gives the switchboard attendant an unobstructed view of all meters and controlling instruments. He is also in position to take a general survey of the whole turbine room. The line panels are vertical, but the generator and exciter board is arranged with a benchboard, and there is an open space between the benchboard and the vertical instrument panels above through which the generators controlled by that board can be seen by the operator without shifting his position. Fig. 18 shows the switchboard.

All oil switches, generator field switches and field rheostats are remote-controlled by means of an auxiliary low-tension system operating at 115 volts. Instruments and switches are mounted on Monson slate, back-connected with wires ending at terminals carefully lettered. The wiring is designed in such a manner that no crossings are necessary, due to careful run of conduit in the operating gallery, where a false floor of Tennessee marble is laid. Mounted on the rear of the panels, but operable from the front, are some interesting new devices known as "test adapters," which make the work of testing meters an extremely simple operation. Instead of the usual methods, including disconnection of wires and the attaching of testing leads by testing men, a simple movement of the adapter by the operator puts the instrument in connection for testing. A testing panel, with standard meters permanently installed, is interconnected with this system. At the rear of the panels the wiring is particularly to be commended for its simplicity and neatness.

A complete signal system between each turbine and its boilers and the corresponding control panel on the switchboard will be at the operator's command. A bulletin board will indicate the actual load on each turbo-generator.

SUBSTATION.

A local substation with the usual arrangement of transformer, rotary converter and switchboard is placed on the first floor at the west end of the switch house. It is of unusual interest because it contains, in commercial service, the first experimental split-pole rotary converter ever built. This type of machine does away with the potential regulator. It has been described in recent papers read before the American Institute of Electrical Engineers, by Mr. J. L. Woodbridge, Mr. Charles W. Stone and Prof. C. A. Adams. (See also ELECTRICAL WORLD, page 386, Feb. 22, 1908.) In any synchronous converter the direct-current voltage has a definite ratio with respect to the alternating-current voltage impressed upon the collector rings and this can be varied within certain limits by changing the width of the pole arc. The function of the regulating pole is to vary the width of this arc and hence the ratio of alternating- to direct-current e.m.f. by assisting or opposing the flux in the main pole. The machine is of 500-kw rating. The output is used at present for supplying energy to lamps and motors in the station. Energy is used also for charging the battery and may be used, as stated, for excitation. The substation switchboard is connected with the Twenty-second Street substation, which may be drawn upon in emergency.

FIRE PROTECTION.

Unusually complete fire protection is afforded at the Quarry Street station. A 1000-gal., 125-lb., centrifugal motor-driven fire pump delivers water to a permanent piping system, with hydrants placed at convenient points about the building and property. An ample supply of hose on reels is accessible for the fire brigade made up of station employees. The piping system has a further connection to the river, by which a fire-boat could force water through it. In addition, there is a similar connection on the street, to which fire engines could be attached. Moreover, the building is as nearly fireproof in construction as human ingenuity can make it.

THE MEN WHO DID THE WORK.

Following is a list of the names of the engineers, architects and principal contractors:

Consulting mechanical engineers, Sargent & Lundy; electrical engineers, engineering staff of the Commonwealth Edison Company; architects, Shepley, Rutan & Coolidge; general contractors, Wells Brothers Company; boilers and stokers, Babcock & Wilcox Company; turbo-generators and exciters, General Electric Company; condensing equipment, H. R. Worthington; boiler-feed pumps, Dean Brothers, of Indianapolis; overhead traveling crane, Whiting Foundry & Equipment Company; coal and ash-handling machinery, John A. Mead & Company; condensing tunnels, Nash Brothers; foundations for machinery, Falkenau Construction Company; boiler setting and lining of ash pits, H. A. Bishop; high-tension switching equipment and control, General Electric Company; excitation battery, Electric Storage Battery Company.

A GLANCE AT THE FUTURE.

It is an interesting commentary on the marvelously rapid development in the art of planning electric power stations and building machinery that the first four turbo-generators in the Fisk Street station, none of them more than five years old, are to be taken out next summer. They have had their day and will be replaced by an equal number of 12,000-kw units. By this change the rating of Fisk Street will be increased by 22,000 kw without any addition in the boiler room except the extension of two stacks and slightly increased grate service.

The Harrison Street station in its day was considered the most economical of the reciprocating-engine stations. Later, under the same management, the most economical of turbine stations was developed. The Harrison Street station has a rating of from 16,000 kw to 18,000 kw with its present engines and generators. Remodeled as a turbine station, it could be made to yield from 40,000 kw to 45,000 kw. Contrasting these figures, it would seem to be within the bounds of possibility to look forward to the day when the last piston engine shall have been abolished in the great stations of the Commonwealth Edison Company.

Bituminous Gas-Producer Electrical Generating Plant.

By Elbert A. Harvey.

THE Garford Company, Elyria, Ohio, manufacturer of automobiles, has a very complete and thoroughly modern manufacturing plant, one of the features of which is a bituminous gas producer, furnishing fuel for engines and other manufacturing purposes.

Like many manufacturing concerns in the Cleveland district and in other natural gas centers, the Garford Company is established on a gas basis. There is cheap natural gas—that is, gas at 25 cents per 1000 cu. ft. for power purposes, and 15 cents per 1000 cu. ft. for furnace purposes. The natural gas is good, and the prices afford a lower fuel cost basis than can readily be obtained by other means.

But the supply of natural gas, however, cannot be depended upon. The gas companies, both in Cleveland and elsewhere, realize that their most legitimate and permanent field is in supplying the individual householder, storekeeper, and the like, and refrain from making contracts with manufacturers with guarantees of ample supply and continuous service. They agree only to give gas when they have a surplus, and as a matter of fact, during every cold snap the gas supply to manufacturers is either cut off or reduced. It is apparent that manufacturers like the Garford Company, with a plant representing more than $1,000,000 investment, cannot afford to run the risk of shut-down on account of the failure of fuel supply. Therefore, while the company avails itself of the low cost and

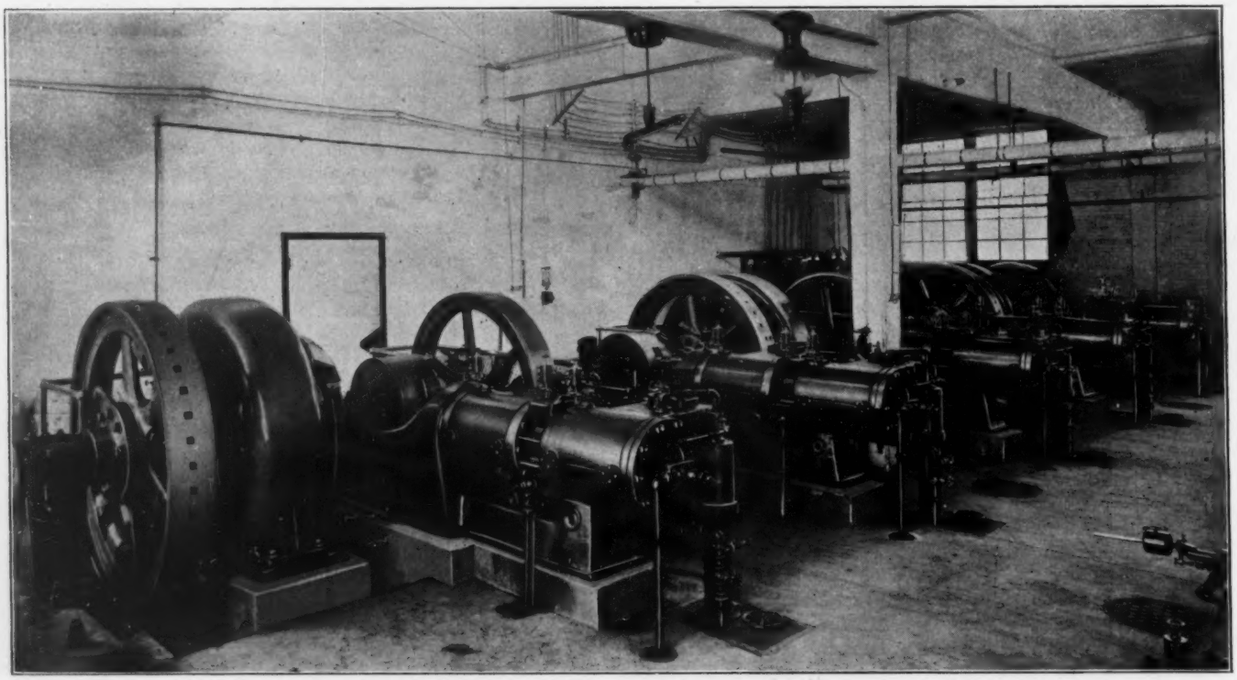


FIG. 1.—VIEW OF ENGINE ROOM OF GARFORD COMPANY AT ELYRIA, OHIO.

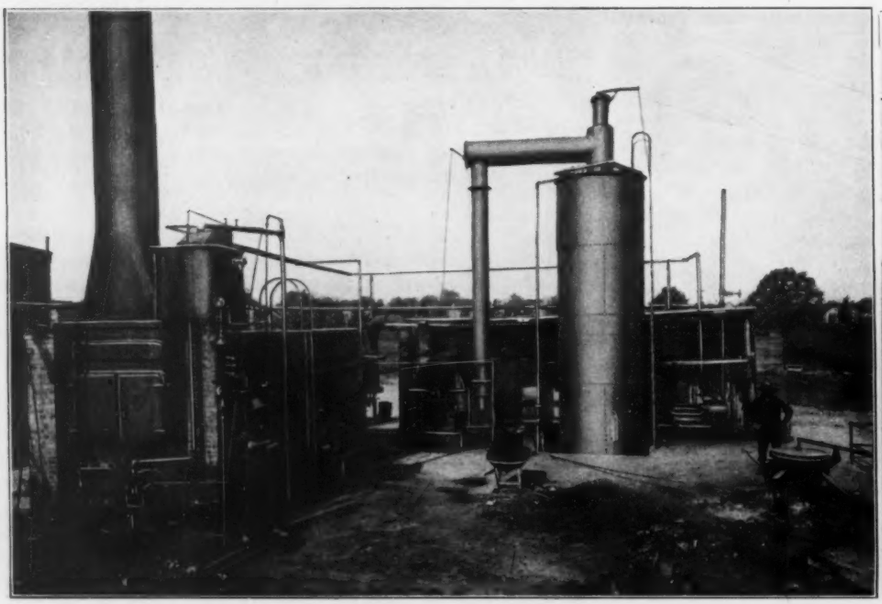


FIG. 2.—VIEW OVER CHARGING PLATFORM SHOWING ALSO GAS WASHER AND TAR-BURNING BOILER.

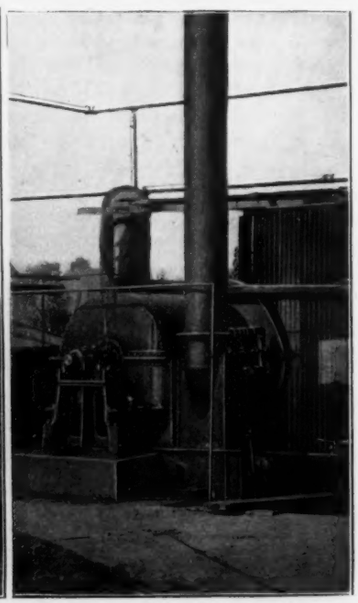


FIG. 3.—ROTARY GAS WASHER.

convenience of natural gas, notwithstanding the instability of the service, as a safeguard it has put in a producer equipment as insurance against shut-down and also for future use when the natural gas gives out or rises in price.

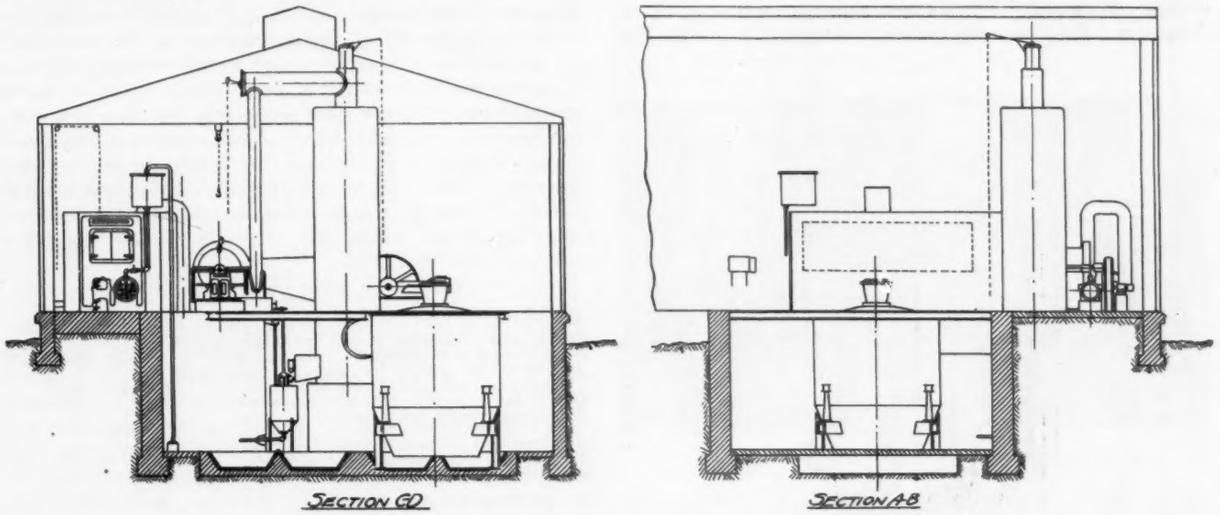


FIG. 4.—SECTIONAL ELEVATIONS OF GAS-GENERATING PLANT.

In the spring of 1907 the company announced to the manufacturers of producers that it was in the market for producer equipment. A large number of bids were received, but only three of them received consideration, viz., those made by concerns who had at that time successful plants operating on bituminous coal. The contract was finally awarded to the Industrial Gas Company of New York. The gas plant selected is an updraft produced with a mechanical tar separator. It is designed to furnish a gas containing the light hydrocarbons of bituminous coal, but entirely free from tar, thus furnishing a clean gas but one comparatively high in heat units.

The plant installed consists of one updraft produced with open water-sealed bottom and four tuyeres for air and steam supply; a cooler, where the gas is cooled by water shower; a rotary gas washer, by which the tar is removed from the gas; a dry scrubber, in which the gas is dried and freed from dust; a small auxiliary steam engine to operate the gas washer; an auxiliary steam boiler fired by tar and gas to supply steam to the engine and to the producer for gas making; a tar outfit by which the tar is collected and burned under the boiler, and the necessary connections and auxiliaries to make up a complete

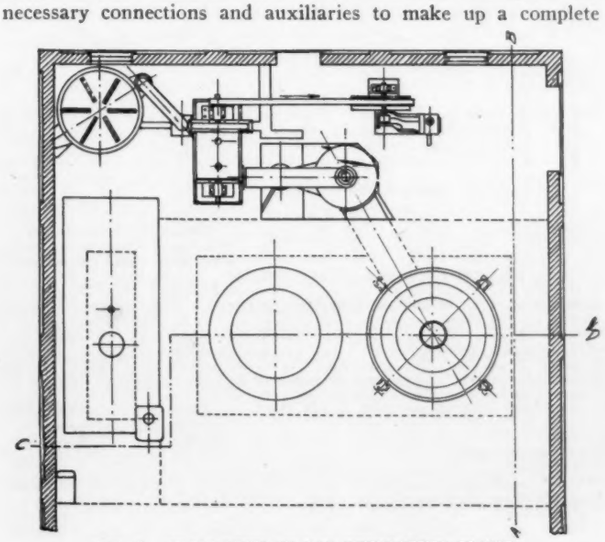


FIG. 5.—PLAN VIEW OF GAS-GENERATING PLANT.

gas-making, gas-cleaning and gas-delivering apparatus. No gas holder is used.

The gas is used in five 100-hp, direct-connected Alberger gas engines, and also in Brown & Sharp case-hardening furnaces and in other furnaces. Owing to the past slack season the arrangement for using the gas in all furnaces has not yet been completed. The gas generator is of the updraft type; each of the four tuyeres is blown by a separate Eynon-Evans steam induction blower, giving good distribution and consequently

FIG. 6.—STEEL FRAME CONCRETE CHARGING PLATFORM.

large capacity and freedom from clinker, and making possible the use of slack coal. The plant was tested out and accepted

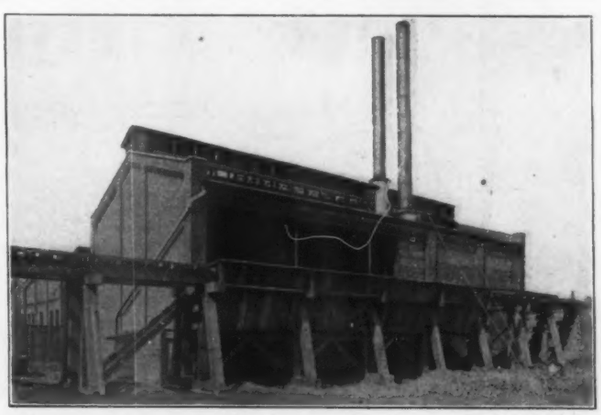


FIG. 7.—GAS HOUSE 2000-HP BITUMINOUS PLANT.

while running 24 hours per day on Ohio bituminous slack coal.

The gas washer is composed of a steel drum cylinder revolving in an enclosing case. The drum is provided with wings,

and as the gas is passed longitudinally through the drum it is given a whirling and spiral motion by the wings, and also subjected to water spray. The tar and water are mixed into an emulsion and thrown out by centrifugal force, the gas passing out cleaned. The machine thus churns the tar out of the gas and simultaneously throws it out of the machine. The

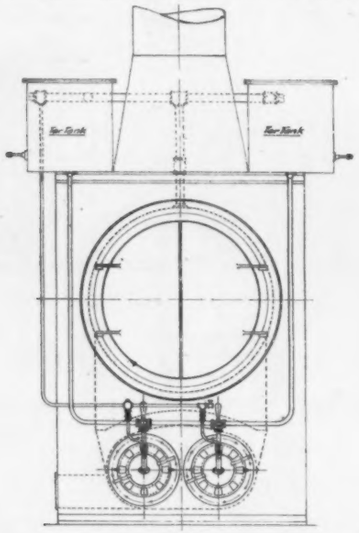


FIG. 8.—FRONT VIEW OF TAR-BURNING BOILER.

machine is built for 24-hour service every day in the year, and the results at Elyria show that it can be counted on to meet these conditions, at least as well as the best electric motors and steam turbines. In other words, the gas washer meets the demands for continuous service in a commercial, practical way.

The tar outfit is an adaptation of a fuel-oil equipment. The tar is atomized by steam and blown into the combustion chamber in the same way as would be oil, but the essential difference lies in the fact that tar is by nature a sticky and non-fluid material. To make it flow it must be heated, and to accom-

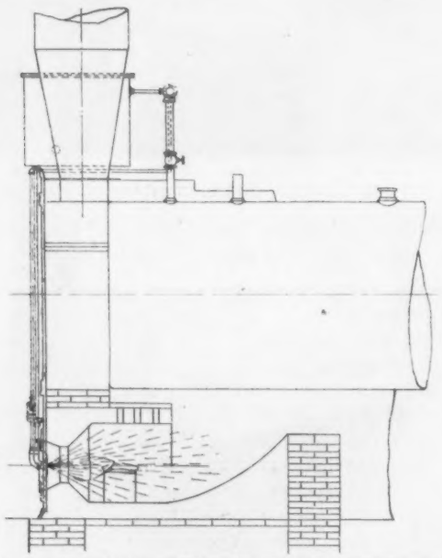


FIG. 9.—SECTIONAL ELEVATION OF TAR-BURNING BOILER.

plish this the entire tar outfit is steam heated. This apparatus was largely experimental when first installed at Elyria, but there has shown itself to be entirely reliable for 24-hour service.

The producer supplies fuel to gas engines having an aggregate rating of 500 hp and consisting of 2½ sets 16-in. x 16-in., 225 r.p.m., "Buffalo" Alberger, twin-tandem, four-stroke cycle, single-acting horizontal gas engines, rated at 200 hp each, direct connected to three 130-kw, 230-volt, direct-current Crocker-Wheeler generators, the armatures being mounted upon the engine shafts between twin sides. The half engine carries a 130-kw generator operated at one-half load, the other half to be installed later.

The table herewith shows the cost per hour to the Garford Company on an average load of 175 kw 3000 hours per year, amounting to a total of 525,000 kw-hours at the switchboard, and gas used in furnaces, averaging an equivalent of 4000 cu. ft. of natural gas per hour during 3000 hours, or a total of 12,000,000 cu. ft. per year. The plant ran successfully for a long period on Ohio slack, but comparative tests determined it was cheaper to use Pittsburgh run-of-mine, on which the plant is now operating. This coal averaged 13,500 lb.-Fahr. heat units per pound, and costs $1.10 at the mine, with $1 freight and 10 cents unloading charge, making the total cost of $2.20 per ton of 2000 lb. in the bins.

FUEL.	Lb.	
Coal burned in producer for gas for engines at 2.18 lb. per kw-hour at switchboard, 175 kw per hour =	383	
Coal burned in producer for furnaces requiring 85 lb. to produce equivalent of 1000 at 4000 cu. ft. per hour	340	
Coal burned in producer for gas burned under boiler	75	
Coal burned under boiler	75	
Total coal per hour	873	
Total coal per day during working hours	8,730	
Stand-by losses at night	500	
Total coal burned per day	9,230	
Cost per year of 300 days, 1385 tons at $2.20		$3,040
The steam furnished by boiler and the coal used by boiler is divided as follows:		
Steam for washer engine, 36½ hp	1,260	
Steam for producer	326	
Steam for tar outfit	286	
Total	1,872	
Supplied by 80 lb. tar	940	
Supplied by 75 lb. coal burned as gas	492	
Supplied by 75 lb. coal burned on grate	440	
Total	1,872	
LABOR.		
One head gas man, 25 cents per kw-hour, 4000 hours	$1,000	
One helper, 15 cents per hour, 4000 hours	600	
One extra man for ash, etc., 18 cents per hour, 1500 hours	270	
Total		1,870
One gas-engine engineer at	$1,500	
One assistant, 22½ cents per hour, 3000 hours	675	
Total	$2,175	4,045
WATER.	Gal.	
Gas engine water, 16 gal. per hour	8,400,000	
Washer water, 1000 gal. per hour	3,000,000	
Cooler, 1750 gal. per hour	5,250,000	
Boiler, 250 gal. per hour	750,000	
At 6 cents per 1000 gal	17,400,000	1,044
MISCELLANEOUS SUPPLIES.		
Oil	$320	
Waste and packing	60	
Sparking plugs	50	430
REPAIRS.		
Estimated by engineer		520
OVERHEAD CHARGES.		
Fifteen per cent on total cost of plant, engines, generators, switchboard, foundations, producer house, engine house, piping, wiring, labor and freight of $51,620		7,743
Total annual cost for power and gas		$16,828

SUMMARY.

	Cost of 525,000 kw-hours.	Cost of equiv. 12,000,000 cu. ft. nat. gas per year.
Coal, 54 per cent for power, 46 per cent for fuel	$1,635	$1,411
Labor, power, all of engine plant, plus 54 per cent of gas plant	3,185	860
Water	795	299
Miscellaneous expenses	330	100
Repairs	440	80
Overhead charges, 15 per cent on investment; power, all engine plant, plus 54 per cent of gas plant; fuel, 46 per cent of gas plant	6,505	1,238
	$12,890	$3,938

Cost per kw-hour:	
Operating	1.2 cts.
Total cost	2.45 cts.
Cost for the equivalent of 1000 cu. ft. natural gas:	
Operating	22½ cts.
Total	33 cts.

In considering the cost of producer gas as compared with natural gas, the Garford Company does not take into consideration the investment, as its engine plant has not been changed on account of the installation of producer equipment, and fur-

ther because the producer plant was put in as an insurance against the loss of natural gas supply. The figures given show that it is making producer gas from bituminous coal at a total cost of 33 cents for the equivalent of 1000 cu. ft. of natural gas and at an operating cost of 22½ cents for the same equivalent, and that it is producing energy at a total cost of 2.45 cents per kw-hour at the switchboard and an operating cost of 1.2 cents per kw-hour. These figures indicate an exceedingly low fuel cost for a plant of this size and show that it is practically a matter of indifference to the company from a financial point of view whether the present cheap supply of natural gas is continued or discontinued. This type of producer gas plant is particularly suited to large installations.

Storage Batteries in Mining Service.

BY GEORGE A. ILER.

What is supposed to be the first storage battery installed for mining service in that part of the country was placed in service at Prudence, Fayette County, West Va., in the plant mining the Sewell Seam of coal. Prudence, which is one of the 28 mines owned and operated by the New River Company, of MacDonald, West Va., and Boston, Mass., is equipped with electric haulage throughout.

The power house for supplying the electric locomotives and

FIG. 1.—STORAGE-BATTERY STATION.

motor-driven mine fans is constructed of red brick with a fire-wall separating the boiler and engine rooms. The boiler equipment consists of three 150-hp return tubular boilers, supplying steam to two 200-hp engines, each engine being belted to a 150-kw, 250-volt generator. At one side of the tipple, and forming a part of it, is an 8000-ton coal bin over the railroad tracks, which enables the mine to run even though there be a shortage in cars. This feature makes it paramount that the machinery shall run every day and without any delays.

There are several openings, all drifts, each opening being ventilated by a large motor-driven fan. The first opening is about ¼ mile from the tipple and turns off inside the tunnel, a 30-hp ventilating fan providing air for this opening. The next opening is at Lyman, 1¼ miles distant, a 30-hp motor-driven fan being installed at this location. The remaining opening is at Jones' Hill, 2½ miles from the tipple, where there is a 20-hp ventilating motor.

The greater part of the coal mined comes from the last-named place and at this point a 4-ton electric mine locomotive is utilized to move empty cars, gather the loads, and transfer to the main side track, from which a large locomotive hauls them to the tipple. Each mine car weighs 1400 lb. and holds 2500 lb. of coal.

The 4-ton locomotive usually makes up trains of about 15 loads for the 15-ton locomotive, which makes an express trip every 60 minutes to the tipple. A second 15-ton locomotive makes similar trips to the first "Roght" and Lyman every 60 minutes, with an average for the day of 10 cars for each trip; this average is low now on account of decreased coal shipments. This makes about 450 tons daily run, or 790 ton-miles at the time data were taken. Since that time the output has run as high as 800 tons per day. With the above brief outline in mind, I will describe conditions before and after the installation of the storage battery.

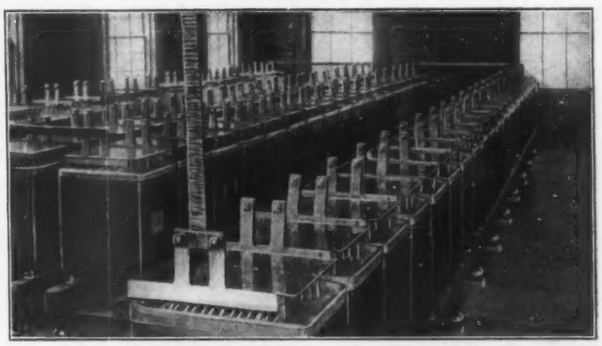


FIG. 2.—INTERIOR VIEW OF STORAGE-BATTERY PLANT.

Both generators were required to run every day at considerable overloads for short periods of time, and the locomotives had to be run on schedule, so that only one would be using power. There is a telephone at each mine station to facilitate this method, but with all this preparation we found it impossible to operate satisfactorily, for the following reasons:

The voltage was so low, due to line drop (as there are only two 4-0 copper wires, including the trolley) that the locomotives would at times come to a standstill, the voltage falling as low as 25 at the motors. Moreover, the ventilating fan motors would decrease in speed to such an extent that the no-voltage release on the starters would open the circuits, resulting in drainage to the commutators and starters, while the mine would be without air circulation. Starting the locomotives was accomplished by a series of jerks, with the result that the armature repair bill on three locomotives for one year was approximately $1,000. In the power house the engines would pound

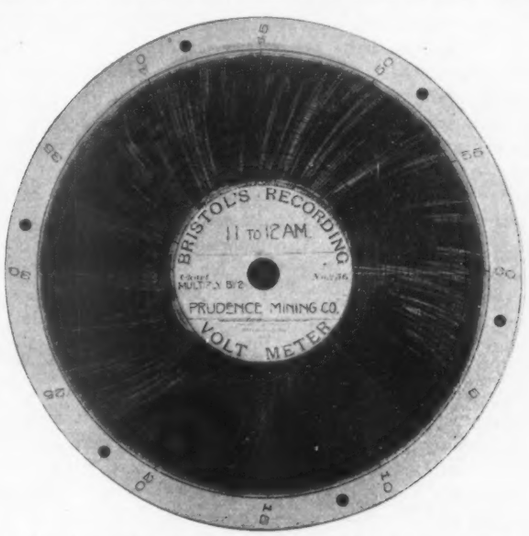


FIG. 3.—VOLTMETER CHART, WITH BATTERY OFF LINE.

badly, owing to the heavy current required to start trains on low-voltage; belts would slip from the pulleys against the pedestal bearings and be damaged, with the general result that at quitting time each day it was hard to say whether or not we would be able to run on the day following.

Several proposals were made by different engineers to remedy all of these troubles. One was to use more copper; another was to change the whole plant to a 500-volt equipment; another

was to use a booster. These solutions were, however, expensive and more or less unsatisfactory.

Finally the writer installed a storage battery of 86 cells of Bijur storage batteries in glass tanks, the present capacity being 540 amp-hours, with an ultimate capacity of 720 amp-hours at the normal eight-hour rate of discharge. The tanks and connecting straps for each cell are large enough to accommodate

FIG. 4.—VOLTMETER CHART, WITH BATTERY ON LINE.

four additional plates, thus providing for future increase without change in the existing equipment. Fig. 2 shows the battery.

The battery house is built of red brick and has concrete floors. A separate room is provided in the battery house for the switchboard; this apartment does not communicate with the battery room, the doors and windows in the latter being fastened at all times. The main-line track runs within 6 ft. of the battery house, and when it is necessary to replace the battery circuit-breaker the motormen, having access to the switchboard room, can do so when they pass with a trip. Any form of signal to announce that the circuit-breaker has opened is unnecessary, as the men operating the locomotives can tell immediately whether or not the battery is in service.

Tests were made before and after the installation of the battery to show the exact operating conditions in each case. These tests were made by means of a Bristol recording voltmeter, using smoked charts which make a complete revolution in one hour. Fig. 3 shows the line voltage at the point where the battery is installed before the battery was put into service. Fig. 4 shows the line voltage at the same point with the battery floating across the line. A comparison of these two charts will show that there is always sufficient power for the motors to operate safely without danger of burnout, and at the same time we are enabled to carry out a satisfactory schedule in handling the coal. Moreover, the line voltage never falls so low as to prevent a reliable air supply being assured.

Shortly after completing the battery installation, one of the generators was badly damaged and had to be shut down for several days for repairs. Just at that time we were supplying power for our Harvey mine over a 4-0 transmission feeder one mile long. We found, however, that we were able to keep both the Harvey and Prudence mines going with only one generator and the battery. It was difficult to do this before with both generators and three boilers. We now find it easier to supply steam with two boilers than it was with three before.

The only attention given the battery is to look it over once a week and take readings of specific gravity and add water to make up for loss by evaporation. The battery has at times been put to some severe use, being subject to discharge at rates considerably over the normal, and has been called on for continuous work to such an extent that the specific gravity of the electrolyte has dropped to extremely low points.

Divisch, a Lightning-Rod Pioneer, 1754.

By Brother Potamian, Sc. D., Lond.,
Professor of Physics in Manhattan College, New York.

It is a matter of history that Franklin erected an *experimental* lightning rod over his house in Philadelphia in the month of September, 1752. We say experimental because the rod was not intended by Franklin for the protection of his home, but rather as a means of drawing electricity from the clouds. Moreover, owing to its want of continuity, it was obviously a source of danger rather than protection. The conductor was made of iron with a sharp steel point rising 7 ft. or 8 ft. above the roof of the building, the other end being sunk 5 ft. in the ground. The two parts of the conductor, viz., the "sky" and the "ground," were separated from each other by a horizontal distance of 6 in. Each rod carried a little gong at its end, with an insulated clapper hanging midway between them. Franklin, being an economist of time, adopted this musical kind of annunciator to warn him of the approach of an electrified cloud. When the clapper played between the insulated gong and the grounded one, the philosopher knew that he had only to step on the landing outside his room in order to avail himself for the purpose of his researches of electricity generated in the vast laboratory of nature. More fortunate than Prof. Richmann, of St. Petersburg, who was killed outright in the summer of 1753 while experimenting with an insulated conductor, Franklin was able to charge Leyden jars with electricity drawn in this way from the clouds and to show by comparison with the electricity developed in his laboratory that cloud-masses are sometimes charged positively and sometimes negatively.

Though the electric chimes, as they are called in textbooks, bear Franklin's name, it may here be said that he was not the inventor of that tuneful piece of electrical apparatus. Seven years before Franklin adopted the device, Andrew Gordon, a Scotch Benedictine, who held the chair of natural philosophy in the University of Erfurt, in Saxony, invented and described it in his *Versuch einer Erklärung der Electricität.* As the question of priority is not without interest in the case of Franklin, we will translate the description which Gordon gives of his bells on page 38 of his book. After stating that he was led from certain experiments which he had made to try an electrical method of ringing bells, he adds: "For this purpose I placed two small wineglasses near each other, one of which stood on an electrified board, while the other, placed at a distance of an inch from it, was connected with the ground. Between the two, I suspended a little clapper by a silk thread, which clapper was attracted by the electrified glass and then repelled to the grounded one, giving rise to a sound as it struck each glass. As the clapper adhered somewhat to the glasses, the effect on the whole was not agreeable. I, therefore, substituted two small metallic gongs suspended one from an electrified conductor and the other from a grounded rod, the gongs being on the same level and one inch apart. When the clapper was lowered and adjusted, it moved at once to the electrified

FIG. 1.—GORDON'S ELECTRICAL CHIMES, 1745.

bell from which it was driven over to the other, and kept on moving to and fro, striking the bells each time with pleasing effect until the electrified bell lost its charge." In the illustration, *a* is connected with the electrified conductor; *b* is the insulated clapper; *c* the grounded gong.

Gordon's book was published in Erfurt in 1745; Watson fully described the "German" chimes in his famous "Sequel," 1746;

while the year 1752 is that in which Franklin applied the chimes to his experimental rod to apprise him of the approach of an electric storm, an application which was original and quite in keeping with the practical turn of mind that characterized our journeyman-printer, philosopher and statesman. Unquestionably, Franklin had all the ingenuity and constructive ability needed to make such an appliance; but there is no evidence that he actually invented it. Though Franklin neither claimed nor disclaimed the chimes as his own, all his admirers would have preferred less reticence on his part when the discoveries and inventions of contemporary workers in the electrical field were concerned, for he attained sufficient eminence to permit him to look appreciatingly and encouragingly on the efforts of others.

Though Franklin erected his rod for the purpose of experiment, he was, nevertheless, well aware of the efficiency of lofty pointed conductors in protecting edifices and ships against the effects of lightning. He expressly says so, and notably in *Poor Richard's Almanack* for 1753, which article contains an excellent set of rules for the erection of lightning conductors for ships and edifices. "It has pleased God in His infinite goodness to mankind," he says, "to discover to them the means of securing their habitations and other buildings from mischief by thunder and lightning. The method is this: provide a small iron rod (it may be made of the rod-iron used by the nailers) but of such a length, that one end being 3 ft. or 4 ft. in the moist ground the other may be 6 ft. or 8 ft. above the highest part of the building. To the upper end of the rod fasten about a foot of brass wire, the size of a common knitting-needle, sharpened to a fine point; the rod may be secured to the house by a few small staples. If the house or barn be long, there may be a rod and point at each end, and a middling wire along the ridge from one to the other. A house thus furnished will not be damaged by lightning, it being attracted by the points and passing through the metal into the ground without hurting anything. Vessels also, having a sharp-pointed rod fixed on the top of their masts, with a wire from the foot of the rod reaching down round one of the shrouds to the water, will not be hurt by lightning."

It is well known, as Dr. Rotch, Director of the Blue Hill Observatory, recently pointed out, that the matter for these almanacs was prepared by Franklin himself under the pen-name of Richard Saunders. As the above passage appeared in the almanac for 1753, it is obvious that it must have been ready sometime toward the end of 1752. Furthermore, we know that it was actually in the hands of the printer in the middle of October of that year, for the *Pennsylvania Gazette* for Oct. 19 says that the almanac was then in press and that it would be on sale shortly. Whence it follows that the year 1752 is the year of the invention of the lightning rod and not 1753 or 1754 as often stated.

Strange to say that in the year 1754 experiments with lightning conductors were made in the heart of Moravia on a scale that transcended anything previously attempted in London, Paris or Philadelphia. The accompanying illustration shows the conductor which Divisch (also Diwisch) raised at Prenditz (also Brenditz) in the summer of 1754 to demonstrate publicly the efficacy of such apparatus for breaking up thunder-clouds and neutralizing the destructive energy pent up in their electric charges. Prenditz, it would appear, suffered severely from electric storms; and it was mainly for the safety of the locality that the country priest devoted himself with earnestness to the study of electrical phenomena.

As such a man deserves to live in the memory of posterity, we have sought out the leading facts of his career mainly from Father Alphonse Zák, of Pernegg, in Lower Austria, a distinguished writer of the order to which Divisch belonged, and have woven such details as we obtained from him and others into the simple narrative that follows.

Procopius Divisch (Prokop Diwisch) was born on Aug. 1, 1696, at Helkowitz-Senftenberg in Bohemia. He spent his youth at Znaim, where he studied the humanities and philosophy at the college conducted by the Jesuit fathers in that Moravian town. In 1719, when in his twenty-third year, he decided to quit the common ways of the world in order to lead the higher life in the Premonstratensian Order at Kloster-Bruck. At the ripe age of 30, Divisch was ordained priest in 1726, after which he taught philosophy and theology to classes of young aspirants to the ecclesiastical state. In 1733 he went to the University of Salzburg and won his double Doctorate in theology and philosophy. Three years later, in 1736, he was appointed parish priest of Prenditz, a small town on the road to Austerlitz, since of Napoleonic fame. Here he remained for five years, returning in 1741 to Bruck as Prior of the Kloster or monastery situated there. At the end of the seven years' war of the Austrian succession, he quitted Bruck, in 1745, for his parish at Prenditz, where he spent the last 20 years of his life in the pastoral ministrations of his sacred office and in electrical experimentation, of which he was very fond.

The curative property of the new agent was heralded throughout Europe about this time in terms of unmeasured praise. Some of Divisch's ailing parishioners, believing him to be an expert in electrical manipulation, applied to him for a little alleviation of their woes. The good-hearted priest did not turn them away, but thought it desirable to treat them to the therapeutic effect of such sparks as he could get from his home-made frictional machine. The results were various, depending probably on the confidence and imagination of the patient. Several remarkable cures seem to have been effected either by

PROCOPIUS DIVISCH.

the electric spark or by the persuasive powers of the operator, or by both combined, with the result that people far and wide were divided in their opinion of the Pastor of Prenditz. Some physicians said that he was interfering with their practice, and even clergymen found fault with him for indulging in work which they thought unsuited to the cloth. A general impression, too, seems to have prevailed that his electrical experiments, especially those with his lightning conductor, were likely to prove harmful in more ways than one.

On the other hand, Divisch had admirers in high places, among whom were the Emperor Francis I. of Germany and his imperial consort, Maria Theresa. Having been invited to Vienna, Divisch repaired to the Austrian capital, where, with the aid of Father Franz, another electrical devotee, he gave a demonstration of the wonderful capability of the new form of energy before the grandees of the empire.

When he came to the electrical property of points, he showed their discharging power in a very original way, one which must have made his assistant uneasy for a while. At times, the machine worked by Father Franz gave excellent results; at others, it failed to generate. It was noticed by the critical few that when the machine failed, Divisch was close by; while when it worked normally he was at some distance away. After a number of such alternations of success and failure which sorely perplexed the assistant, himself a man of renown in Vienna, Divisch explained the occurrence by saying, with a merry twinkle in his eye, that the failure of the machine to

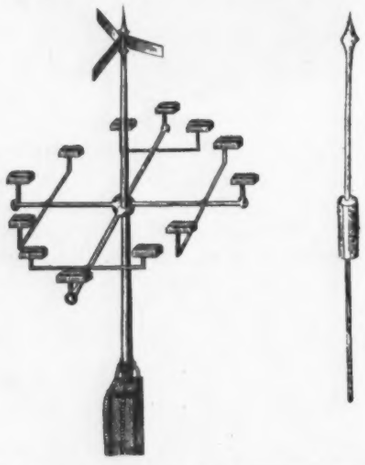
generate when he was close to it, apparently seeking out the cause of the breakdown, was due to a number of pin-like conductors which he had concealed for the purpose in his peruke and which neutralized the charge on the rotating generator!

The identity of the lightning of our skies with the artificial electricity of our laboratories was suspected by many before the middle of the eighteenth century. Englishmen like Hauksbee, Hall, Gray, Freke, Martin and Watson; Germans like Boze and Winkler and Frenchmen like Abbé Nollet, had already published their suspicions and conjectures anent the matter. Franklin, too, had indicated 12 points of analogy between the two in 1749 in his letter to Collinson of London. Though he felt the force of the analogical argument, he also felt that the matter could not be definitely settled without an appeal to experiment. Accordingly, he added: "The electric fluid is attracted by points; we do not know whether this property is in lightning. But since they agree in all the particulars wherein we can already compare them, is it not probable that they agree likewise in this? Let the experiment be made."

In writing to Collinson in July, 1750, he tells his London friend how the experiment may be made: "On the top of some high tower or steeple, place a kind of sentry-box, big enough to contain a man, and an electrical stand (insulator). From the middle of the stand, let an iron rod rise and pass, bending out of the door, and then upright 20 ft. or 30 ft., pointed very sharp at the end. If the electrical stand be clean and dry, a man standing on it, when such clouds are passing low, might be electrified and afford sparks, the rod drawing fire to him from the clouds."

The experiment was made by Franklin himself by means of his kite two years later, in the summer of 1752, and also by the lightning rod which he erected over his own house in the autumn of the same year. Doubtless Divisch heard of the marvelous effects obtained from d'Alibard's insulated conductor at Marly in May, 1752; at any rate, he prepared a conductor of his own and carefully described it in a letter which he sent shortly after the death of Prof. Richmann, of St. Petersburg, in 1753, to the celebrated Euler, then Director of the Academy of Sciences of Berlin.

This remarkable lightning conductor (Figs. 2 and 3) was attached to the upper end of a series of poles 130 ft. in height, erected in an open space some little distance from the rectory. As will be seen from the illustration, it bristled with points, for the Bohemian wizard argued rightly that five points would be more efficient than one, and 50 more efficacious than five. The weird-looking structure destined to ward off the lightning of heaven had no less than 325 well-distributed points. Lodge says in his *Lightning Conductors:* "Points to the sky are recognized as correct; only I wish to advocate more of them, any number of them, like barbed wire along ridges and eaves. If you want to neutralize a thunderbolt, three points are not as effective as 3000." This was written in 1892; nearly 140 years before that date, we find a simple parish priest of an obscure village in Moravia using precisely such a multiple system of short, pointed conductors for the protection of life and property. This lightning conductor or *metcorological machine,* as Divisch called it, was erected by him at Prenditz on June 15, 1754. On the top of the rod will be seen three light vanes which were added in the interest of the feathered race in order to prevent incautious members from incurring the risk of electrocution by alighting on the apparatus during a storm. The wind whirled the vanes round like the cups of an anemometer, and thus kept the birds away from the zone of danger.



FIGS. 2 AND 3.—THE DIVISCH LIGHTNING-CONDUCTOR.

Several trials came to the electrical pastor, and from quarters least expected. It happened in the second year after the erection of the apparatus that the summer was unusually dry, in consequence of which the crops failed almost completely. The farmers of the neighborhood were always suspicious of the strange-looking mast at Prenditz; and, be it said, that they were more than diffident about the propriety of interfering with the forces of nature even under the plea of protection, forgetting that they took great care to protect themselves against heat and cold, rain, snow and hail. The country ladies, no doubt, used parasols for one kind of protection; and the gentry, umbrellas for another. Anyhow, the people of Prenditz and the good folk around did not like the lofty mast with its outstretched arms and bristling rows of suspicious-looking iron points connected to the ground by means of four long, heavy chains. For the nonce, they deemed their pastor a queer fellow, who thought that he could avert the anger of heaven by the oddest kind of a machine which they ever laid their eyes on. It was argued in the councils of the hamlets that whatever advantages Divisch claimed for his "machine," they were all of a negative character. It *prevented* the lightning stroke, he said; that might be, but they did not *see* the prevention. What they did see and keenly realize was the failure of their crops. That affected them very closely; and if, as they supposed, the apparatus of Prenditz had anything to do with it, the sooner they got rid of the machine the better. Divisch, it must be said, was liked by his people; but despite his popularity, the men of violence carried the day and the machine was doomed. Popular passion, excited by personal interest, got the better of the consideration due to the pastor. On an appointed day, a band of bellicose farmers came down on the village and wrecked the apparatus which had cost the priest so much thought and manual labor and on which knowingly and justly he relied for the protection of the homesteads of his rustic flock.

FIG. 4.—SET OF POINTED RODS.

This recalls a similar incident of mob violence which occurred at St. Omer in the north of France, where a manufacturer of that quaint old town who had been in America and seen the usefulness of lightning-conductors, proceeded to erect one over his own house. Hardly was it completed before the populace gathered together; and, when passion was sufficiently aroused by inflammatory remarks of the demagogues, the house was attacked and the conductor torn down. The manufacturer complained of the inaction of the "gardiens de la paix" and appealed to the courts to uphold his right to protect his home against lightning. He entrusted his case to a brilliant young lawyer, as yet unknown to fame, but one destined to achieve unenviable notoriety during the revolutionary period. This, the first defender of the lightning-rod in a court of justice, was Robespierre.

The news of the untoward event soon reached the ears of the Premonstratensian's superiors at Kloster-Bruck; and, as they very wisely considered that the duty of a country priest is primarily to attend to the spiritual welfare of his people, rather than to invent machines for their protection against

the bolts of heaven, they advised him to yield to the prejudice of his flock and not reconstruct the objectionable apparatus.

Father Divisch accepted the friendly advice of his superiors and obeyed like a good Premonstratensian monk. The remains of the shattered "meteorological machine" were sent to the abbey at Bruck, where they could be seen for many years afterward. As a consequence of this act of vandalism, Divisch gave up experimenting with lightning rods and with electricity itself. The villagers were satisfied, but the world at large lost the benefit that might accrue from the researches on atmospheric electricity which Divisch would have carried on during the remaining 19 years of his life.

In giving up electricity, the disappointed priest turned his attention, first, to acoustics and then, practical man as he was, to the construction of musical instruments. It was not long before his genius brought out an orchestrion of wind and string instruments which was played like an organ with hands and feet, and which was capable of 130 different combinations. Prince Henry of Prussia offered a considerable sum of money for the invention, but Divisch died while the preliminaries of sale were arranging and negotiations were broken off. The instrument remained for many years in the abbey at Bruck, where it was in daily use for the canonical office.

It is a curious coincidence that Franklin was also interested in musical instruments. He is credited with having devised an improved form of glass harmonica, one of which he presented to Queen Marie Antoinette.

Despite the bitter experience of Divisch, the introduction of lightning conductors into Italy was warmly advocated some years later by Padre Toaldo (1719-1797), an admirer and correspondent of Franklin. It was through his influence and personal activity that the magnificent thirteenth-century Cathedral of Siena was protected with lightning conductors after having been repeatedly struck during the centuries and seriously damaged. Toaldo published in 1774 his celebrated work on the protection of public edifices and private buildings against lightning; it contributed greatly to reassure public opinion on the value of "Franklinian rods," as the conductors were commonly called.

It is a matter of regret that Franklin used the words "the electric fluid is attracted by points" in the passage quoted above inasmuch as in the popular mind such "attraction" courts rather than averts danger. This is not so; for the rod no more "attracts" lightning than a rain-pipe attracts a downpour. Franklin knew very well the twofold protection of his rods, the *preventive* by which they tend to ward off the stroke by gradually and silently neutralizing the excessive energy of the cloud; and the other, the *preservative* by which they convey the discharge safely to earth when struck. He even complains of people who concentrate their attention on the preventive function, forgetting the other entirely, adding that "Wherever my opinion is examined in Europe, nothing is considered but the probability of these rods preventing a stroke, which is only a part of the use which I proposed for them; and the other part, their conducting a stroke which they may happen not to prevent, seems to be totally forgotten, though of equal importance and advantage." (1755.)

The experience of more than a century shows that the lightning-rod affords protection in the great majority of cases; but it would be, at least, a mild exaggeration to say that it never failed when properly constructed.

At one time it was customary to make the rods rise to a considerable height above the building in the belief that the diameter of the circle of protection was four times the height of the rod. Such a rule was an arbitrary one which facts soon showed to be unreliable and unsafe. It is now recognized that there is no such thing as a definite area of protection.

Were this a literary article, we would point out that either of the expressions "electric" storm or "lightning" storm is preferable to *thunderstorm*, because electricity or lightning is the active agent or principal feature of the impressive phenomenon. No one thinks of calling a hailstorm by the descriptive term of *patter* storm; yet that would be just as logical and appropriate an appellative in one case as thunderstorm is in the other. The expression *thunder and lightning* is illogical because it puts the effect before the cause.

Thundertube is certainly a startling misnomer applied to the long, narrow, glazed tubes formed in siliceous materials by the fervid heat of the flash but not in any way by the sound-waves produced by the crash. *Thunderbolt* does not mean despite the common opinion, a white-hot mass that accompanies the discharge; it is purely and simply the flash itself. A glowing mass that happens to come down in the track of the discharge is a *meteorite*, a body of cosmic and not of terrestrial origin, a visitor from space that chose the rarefied path of the flash for its descent to earth.

Again, there are no *thunder clouds* in nature, only electric clouds; nor is there ever *thunder in the air* save when the lightning breaks from cloud to cloud or leaps from cloud to earth, or strikes from earth to cloud. But though thunder is only occasionally in the air, electricity always is. We have a normal electrical field in all seasons, times and places.

Though it is the lightning that kills and not the thunder, we would not object to the following inscription, which we found on a tombstone:

"Here lies [so and so], oh! what a wonder,
She was killed outright by a peal of thunder,"

because the suddenness of the peal may have given the aged lady a shock from which her failing heart was unable to recover.

We are well aware that such criticism of technical terms in popular use will have no reform effect whatever; because as long as people will say "the sun rises" and "the stars set," they will continue to speak of thunder and lightning, of thunder-clouds and thunderstorms, thundertubes and thunderbolts. Though containing an element of error, these expressions have the sanction of centuries; and so, they have come to stay.

Returning to Divisch, that worthy priest and able electrician died at Prenditz in his sixty-ninth year on Dec. 21, 1765, and was buried in the little churchyard where he had blessed many a grave during the 25 years of his ministration. A simple inscription marks the place of his interment, but a monument will soon be erected to his memory which will tell the passerby where sleeps the Premonstratensian pioneer of the lightning rod.

The chief work of Divisch in print contains his views as a philosopher on the electricity of the atmosphere and is entitled *Theorie von der Atmosphärischen Electricität*, Tubingen, 1765. For the events of his life, the following may be consulted: Gerber, "Hist. biogr. Lexikon," 1812; Meidinger, "Geschichte des Blitzableiters," 1888; Goovaerts, "Ecrivains, artistes et savants de l'Ordre des Prémontrés," 1900, and "Die Gartenlaube," 1878.

Effect of the Recent Drought Upon Water-Power Plans

The drought of the last six months has been the most serious the country has experienced in a number of years. From all sections bereft of snow-capped mountains have come reports of the trouble and loss due to water famine. In New England mills were shut down or run on part time; in the Middle States, pebbles and rocks marked the route over which small rivers once flowed, and throughout the whole East manufacturing and generating stations depending on water power were greatly inconvenienced. In order to ascertain to what extent hydro-electric light plants were handicapped by the drought, a number of letters were sent to companies in the East, requesting information on water power conditions and also on the emergency methods used to carry the load. The replies secured from a number of these plants are given below:

Mr. Silas Faber, Treasurer, Moravia Electric Light, Heat & Power Company, Moravia, N. Y.:

We are located on a stream called Dutch Creek, which is supplied as a rule by springs and drains in the neighborhood of from 10 to 20 sq. miles. Where our plant is located we have

a fall of 120 ft. Our dam is of concrete, 12 ft. high, 120 ft. long and impounds approximately 576,000 cu. ft. of water when full. During June we were able to maintain service from 4:30 p. m. until 8 a. m., without any trouble. Beginning with July 1st, we were obliged to cut down service to the hours 5:30 p. m. to 1 a. m., which we mainained until about the first weeek of August, when we were obliged further to curtail to the hours 6:30 p. m. to 12 midnight. About Aug. 18 we were forced to resort to our steam auxiliary for two nights each week, Sunday and Friday. On Sept. 5 we began some needed repairs to our penstock, being thereby obliged to operate with steam until Oct. 8, since which time we have been able to operate on an average of from 12 to 36 hours per week at our water plant. With the exception of a few minor mishaps, we have given almost uninterrupted service for the hours mentioned. In the immediate neighborhood there are only two or three small water powers which are used to operate feed and saw mills. The low water has had a more serious effect upon these than upon our plant because they are all operated on lower pressure.

Southern Dutchess Gas & Electric Company, Fishkill-on-Hudson, N. Y.:

We have two water turbines of a total capacity of 360 hp, which usually run short in the summer months, but we can generally get the full power for about nine months. We are now getting about 25 per cent of their rated power and have not done much better for the three months past.

Mr. L. N. Wheelock, Manager, Claremont Power Company, Claremont, N. H.:

Our new hydro-electric plant at Cavendish began operation Oct. 5, and it is difficult to state just what effect the drought has had, as we have not yet operated a full season; we have, however, had about the flow that we figured as a minimum, although we are told the river is the lowest it has been known for 40 years. Our plant on Sugar River at Claremont has been practically useless for the past four months, giving less than one-fourth of the low water power. We have a steam plant and a Diesel oil engine plant at Claremont which has tided us over.

Keeseville Electric Company, Keeseville, N. Y.:

On the Ausable River the power has been quite seriously affected by the long-extended drought of this summer, and in fact the two previous winters have been rather against us on account of the light amount of snow and the great amount of frost, which resulted in freezing up the springs. The watershed of the Ausable River is a very interesting one, in that it is well forested, much more so than that of most rivers. The run-off on the average is very satisfactory per square mile of water-shed, and the powers are for that reason as a rule quite reliable. The fact is that we have had no rains of any amount since early summer and our water supply has been short. This fault is to some extent aided by the fact that the Rogers Company at Ausable Forks, some 12 miles above us, stores up the water from the west branch and discharges it at its convenience, which makes a little difficulty for us. Fortunately, we have some reserve power under temporary lease which we can use and which will probably pull us out of our troubles this winter. The trouble is not alone with the interests which we have, but with other interests on the stream also. In this connection it might be of interest to note an observation of conditions on the Ohio by one who recently visited Parkersburg, W. Va. The water there was then so low that it was said that at places one could cross the Ohio dry-shod stepping from stone to stone. It is said also that such conditions have not existed for 80 years before.

Mr. Henry Burden, 2d, President and Treasurer, The Cazenovia Electric Company, Cazenovia, N. Y.:

We have a head of 12 ft. and an average flow of about 5,000 cu. ft. per minute. We operate a pair of 21-in. Victor horizontal turbines that give 94 hp at 233 r.p.m. A 14 in. belt transmits power of the wheels to a jack shaft whence the generators are driven by belts. The past summer we have had fair assistance from our water, but, of course, it has been nothing to what it should have been to be satisfactory. We have to use a 125-hp engine backed by three 70-hp boilers equipped with Jones stokers to furnish us power for peak loads and summer load when we are supplying power for our local canning establishment. We have thus far been able to meet all emergencies, but our profits will be severely cut this year, as we have had to buy nearly twice as much coal as would usually be the case. Not much lumbering has been done here for many years until this season. The high prices offered for wood in any form are beginning to have effect, and wholesale cutting has begun in some quarters. We shall try and induce people to plant as well as hew down, as we think only by this method can our power sources be preserved.

Mr. A. C. Dunham, President, Hartford Electric Light Company, Hartford, Conn.:

We have a record of two water powers which we have been using for 10 years, but have not used the whole of the power developed for more than five years, since which time it has gradually become a smaller and smaller percentage of our total output. The two powers are installed for an output of about 2500 kw, which they will easily give us on a full run of water. We have actually received from them in the five years about 1300 kw average, and we have come to the conclusion that, as the powers are on the Farmington River, which has a reservoir at Otis of sufficient capacity to run the entire plant three months without increase of water, these powers are as good as any in New England which are fed by a large watershed; in other words, if anyone develops a water power which justifies a certain rated capacity in machinery, they can expect in New England to get about one-half of this power delivered through a term of years. Of course, this has gradually changed our views about the value of water power. For the last three months we have practically received only about 20 per cent of our rated capacity in the average. You will readily see that a concern which is doing an active and growing business must expect to put in steam machinery to supplement the water power of about one-half of the capacity of the latter. For instance, if we do business as now, absorbing our entire water power, and considerable more in steam besides the water power insurance, we must reckon that insurance at about two-fifths of the rated capacity of the water power; and when you compute the cost of the installation, which is about three times greater for water power installed in the best manner and at the lowest price, the steam installation being also of the most modern description, the water power will cost fully three times what steam power will cost to do the same work. Now, when all the computations are made and the difference in the labor, interest, wear and tear and general maintenance been ascertained, as nearly as we can make the figures, we find that our water power and steam power are almost equal in cost per kw-hour delivered. Nothing is gained by putting in water power unless in places like Niagara Falls, or the snow regions of the West where the water power is constant. In fact, you have an overhead expense which is continuous in the water power as against an overhead expense in steam which may not be continuous, which is in favor of steam. At the present time, and for the last three months, we have been losing not only what we paid on contract for water power, but we are losing on the water power which we own and do not rent.

Mr. John S. Bleecker, Manager, Columbus Power Company, Columbus, Ga.:

The drought that has been serious in other sections of the country did not affect us to any marked degree. Our low-water conditions this past season were normal, requiring the operation of our auxiliary steam plant about the same as last season. In view of the comparatively large forest area in the water-shed of the Chattahoochee River, the flow of the stream has not, for some years, approached the minimum flow on record. There is available at low water approximately 2000 kw, and the deficit has been taken care of by our auxiliary steam plant, built with a view to meeting all requirements of this nature.

Mr. S. A. Roelofs, Vice-President, Pennsylvania Power Company, Ellwood City, Pa.:

Owing to the destruction by fire of our water-power electrical

plant early in March last, we have not suffered any inconvenience by reason of the drought, as the water end of the plant has not yet been rebuilt. The company furnishing water to the public in this city and the territory adjacent thereto, which is closely connected with this company, has its pumping plant on the Slippery Rock Creek, which has its source in Butler County, Pa., and is made up largely of springs. The water company has suffered no inconvenience whatever so far as the supply was concerned, notwithstanding the fact that the creek has been lower the last three months than at any time in the last decade. At its lowest stage it flowed about 11,000,000 gal. of water per 24 hours, as determined by weirs placed at different points in the creek. Our daily requirements do not exceed 2,000,000 gal.; consequently, as stated above, we suffered no inconvenience whatever.

Mr. C. W. Hazleton, Treasurer, Turners Falls Company, Turners Falls, Mass.:

During the past four months the flow of the stream at this point has been approximately two-thirds of what we consider normal or average low-water flow. The natural conditions in the territory constituting our watershed are without doubt similar to those existing at the present time on all natural streams that have no large amount of storage, and, as a result of those conditions at low water, power and output have had to be shut off accordingly. All of the evidence relating to our condition goes to show that the present drought is exceptional both as to extent and duration. There is no question, however, but that the cutting off of the forests and destruction of other natural growth by fire has an important bearing on the average amount of water available for power purposes during a normal low-water season; and it is also as clearly evident that the remedy, to some extent, for this inequality of run off and flow lies in the carrying out of the effort now being made to preserve the forests and prevent as far as possible a change in natural conditions that have so much to do with the regulation of the flow of streams.

Mr. J. D. Mires, Assistant Secretary, The Earlville Electric Light Company, Earlville, N. Y.:

Concerning the present water-power conditions in this locality, we seem to be getting our share of the general drought. We have the only water power in this village, and if we were to lay aside our memorandum of the high-water marks, we might be unable to locate the stream again. Under normal conditions we have about 75 hp, except in times of especially high water or in periods of drought in the latter part of the summer. Probably it would be safe to assume that our power would average about 50 hp for 24 hours throughout the year. We are using this power for two purposes—to carry on the manufacture of wagons during the regular hours, and to furnish power for the Earlville Electric Light Company at night. The units are one 35-hp and one 60-hp Genesee turbines, also one 60-hp Porter engine, and about two months ago we installed a 150-hp "Straight Line" engine. The electric light company uses the power for driving a 60-kw alternator, but when the water power diminished during the past few months until there was only about 35 hp available, and that for not more than two to five hours, we found it necessary to put in a steam engine large enough to carry the entire load. We can hardly see the reason for diverting the available water power of the Chenango River to the Erie Canal, when such use compels us to resort to steam for power whenever we have a drought.

Mr. H. E. O'Neil, President, St. Regis Light & Power Company, St. Regis Falls, N. Y.:

The river on which we are located is exceptionally good as regards uniform flow. The stream is not large, but has a great deal of natural storage. We are located on the east branch of the St. Regis River at St. Regis Falls, and above the plant it is nearly all level water, while below it is nearly all rapids. The level water above aggregates about 50 miles in river length, and in addition there are other great natural reservoirs, including Meacham Lake, Osgood Pond, St. Regis Lakes and many smaller ponds. We have never been troubled seriously for water except in 1903 and this year, and only very slightly. We operated our plant by water every day, and satisfactorily, except that there was low voltage part of the time. However, I do not think that our experience is the rule.

Mr. R. W. Hemphill, Jr., General Manager, Washtenaw Light & Power Company, Geddes, Mich.:

While we operate three water-power stations on the Huron River in this vicinity, we also have an auxiliary steam plant. We are unable to tell the exact proportion of current generated by steam or by water, as we operate from the same line shaft. We do know, however, that we have had the greatest drought in this region of which there is any record, the record running back 38 years.

Mr. L. C. Piser, Shushan, N. Y.:

We supply a small town of about 400 with electricity for light in connection with our shirt manufacturing plant. We also use electricity in our factory for turning machines, light, etc. We have been more or less bothered since September by low water, but during the last month the matter has reached an acute stage. The town is not large enough to support a steam plant, and unless we have a continued rainy spell for at least 10 days before the river freezes up, we will be forced to drop our outside lighting and run our factory by gasoline. Our plant is situated on the Battenkill, which rises in the Green Mountains and feeds the Hudson. It is fed by numerous mountain brooks, and at the approach of cold weather these shrink in volume, the smaller ones disappearing entirely. There is some talk of a state dam above us to regulate the spring freshets, storing the water for use in dry seasons. During heavy rains we have freshet conditions which do considerable damage and at the same time interfere with our power for 24 to 48 hours at a time on account of backwater. Our wheels, two in number, are rated at about 90 hp. A gristmill next us has three old-style wheels which take a large amount of water and which run 24 hours a day or nearly so. Across from us is a machine shop which runs one wheel rated at about 60 hp. In normal seasons, with the water spilling nicely over the crest of the dam, we have water to spare and the stream could probably support twice the wheels now running.

Mr. A. Thornton, Secretary and Manager, Heuvelton Electric Light Company, Heuvelton, N. Y.:

The water conditions of our plant became serious during the drought, when the water was the lowest ever known in this vicinity. We met the condition by putting in a new 60-in. water wheel, making three now in use. The horse-power as given by water-wheel tables for normal conditions, is as follows: For a 56-in. wheel, 40 hp; for a 56-in. wheel, 80 hp; for a 60-in. wheel, 90 hp. The head is 9 ft. During normal seasons 500 hp could be developed.

Mr. W. T. Thayer, Vice-President and General Manager, Chasm Power Company, Chateaugay, N. Y.:

The recent drought has not affected the output of our plant as yet. We have, therefore, not been obliged to use any auxiliary or supplemental power. The Chateaugay River, on which our plant is located, is the outlet of Upper and Lower Chateaugay Lakes. At the outlet of these lakes there is a dam, and we have control of the water at the dam, thus enabling us to have a constant flow of water during the dry season.

Mr. W. S. Stratton, Superintendent, Wadhams and Westport Electric Light & Power Company, Wadhams, N. Y.:

We operate at Wadhams a 300-kw three-phase generator, 24-hour service, for supplying power in the iron ore mines at Mineville. During the drought the output was reduced about one-third per day. The Boquet River furnishes the water, giving a 48-ft. head. On Sept. 1 a 100-kw generator was installed to run the lights here and at Westport. At Kingdom, seven miles away, we have a 400-kw generator, which was run in parallel with Wadhams. Kingdom generated full power up to Sept. 15, when the storage of water gave out, and power cannot be furnished until rain falls or the snow melts. To provide against another drought the storage has been increased by adding 3 ft. to the height of the dam. The water used at Kingdom is used again at the Wadhams power house.

Chart for the Calculation of the Size of Copper Conductors in Transmission Lines.

By L. A. Herdt.

FOR the calculation of the size of copper conductor in alternating-current transmission lines the ordinary vector diagram, Fig. 1, giving the relation of the e.m.fs. on line, load and generator, is well known.

Mr. R. D. Mershon in his article originally published in the *American Electrician*, June, 1897, and reproduced in the *Electric Journal* of March, 1907, worked out a chart as an extension to this vector diagram and with this chart the drop in alternating-current lines can be easily calculated. Assuming the size of wire and knowing the amount of power to be delivered, the power factor of the load, voltage at the receiving end, distance of transmission and frequency, if the resistance volts and inductance volts are expressed as a percentage of the delivered

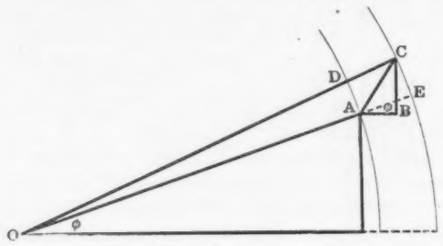


FIG. 1.—CURRENT AND E.M.F. TIME-PHASE RELATIONS.

e.m.f., the line loss and line drop are obtainable in per cent from the chart.

If specific losses and line drop are assumed, the problem which the engineer is called upon to solve is to find for a given amount of power delivered, at a given voltage, the proper size of the wires and their spacing. In this case the use of Mershon's chart will necessitate several trials before the size of the wires is derived.

The present article is intended to describe a chart giving the size of wire and spacing for an assumed *line drop, which, expressed in per cent of the receiver voltage, determines the regulation.**

The foundation of this new method is the ordinary diagram of Fig. 1.

The line drop is DC, the difference between OC the generator voltage and OA the receiver volts. That is, DC, the radial distance between two circular arcs with OC and OA as radii, gives the regulation volts or line drop. In this diagram Φ is the angle between the receiver voltage and the load current; AC is the impedance drop of the line; AB the resistance volts, and BC the inductance volts.

If the line OA be extended to the outer circle, AE also represents the regulation volts and the angle $EAB = \Phi$.

This diagram as a vector diagram can be drawn to scale for any particular problem in line transmission, but again it may be drawn showing the regulation volts or line drop per mile per ampere for any line.

Fig. 2 shows a chart with the resistance volts per mile of line per ampere as abscissas and the inductance volts per mile of line per ampere as ordinates, for different sizes of wires at different spacings. In this way there is obtained a series of

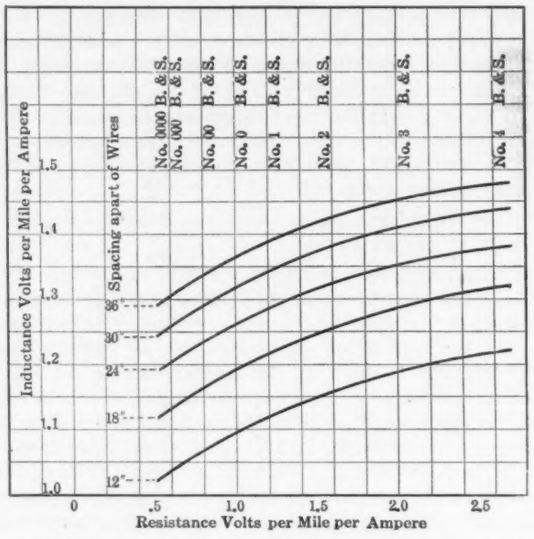


FIG. 2.—CHART OF RESISTANCE VOLTS AND INDUCTIVE REACTANCE VOLTS.

curves, one above the other, each being the locus of the point C in the vector diagram of Fig. 1, for some particular spacings of the wires. These curves are referred to only the point A,

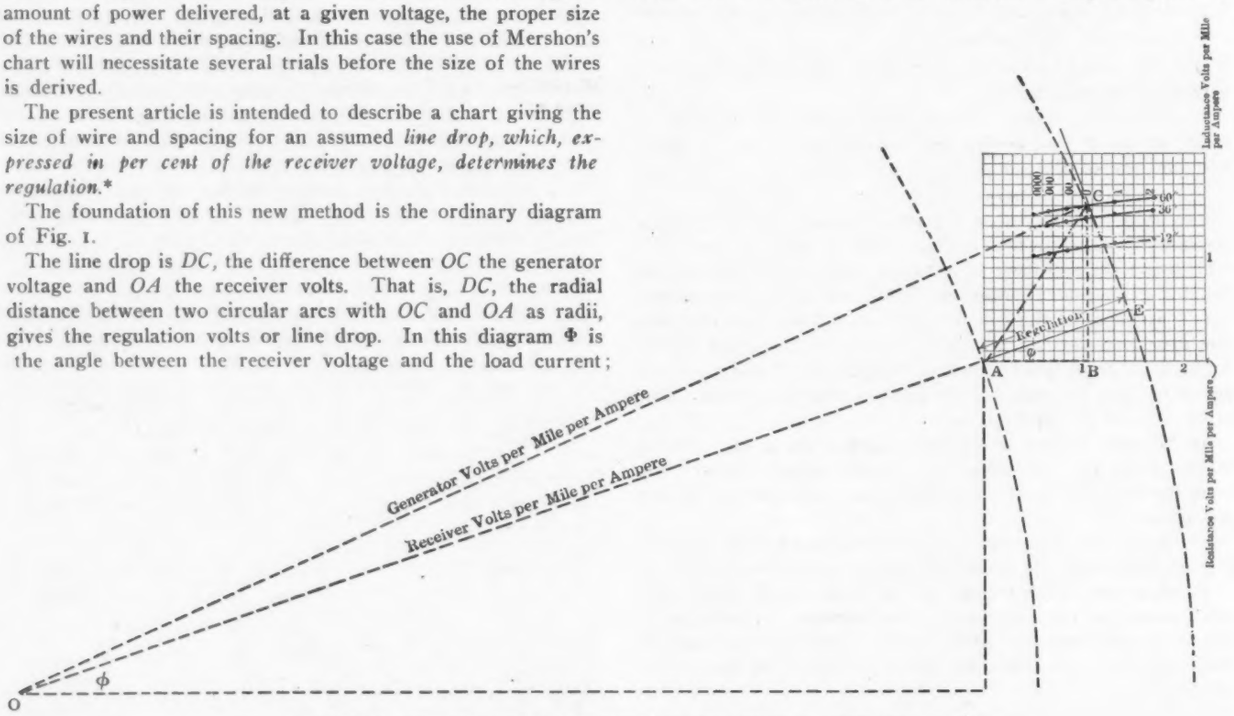


FIG. 3.—DIAGRAM SHOWING THE SIGNIFICANCE OF THE CHART ILLUSTRATED IN FIG. 2.

and the line AB, in the vector diagram of Fig. 1, for their position.

If this chart is placed at the point A, as shown in Fig. 3, and the line OA is extended a distance AE equal to the line drop or regulation volts per mile of line per ampere, the size of wire showing this line drop will be given by the point of intersection of an arc drawn from the point O and radius OE, with the curve worked out for the particular spacing assumed.

*In this paper the term "regulation volts" means the rise of e.m.f. that is necessary at the generating end to keep the receiver e.m.f. constant.

In Fig. 3 this point, which is *C*, shows at the intersection, for 60-in. spacing, that No. 0 is the size of the wire.

If in place of the arc *CE* a line at right angles to *AE* from the point *E* be drawn, it will give practically the same intersection point *C*. By doing so one avoids all references to the point *O* and the whole diagram consists only of the chart shown in section squares. The chart can then be enlarged to any desirable size. The approximation employed in the method—namely, that a straight line at right angles to *AE* can be taken in place of the arc *CE*—evidently involves an error, but this error is very small in comparison with the changing of the size of wire by one number on the B & S gage. If, however, the size of wire is given, the regulation volts or line drop determined from the chart will be somewhat larger than the true value. With leading current, or unity power factor of load, and frequencies above 60 cycles, the error introduced is large and the chart is, therefore, inaccurate for determining regulation.

For power factors—lagging current—less than unity and a line drop not exceeding 20 per cent of the receiver voltage with frequencies of 60 and lower, the error is negligible and the use of the chart will give values of regulation as close as can be obtained by any other graphical method known to the writer, or even from analytical methods when using the slide rule to shorten the work.

Fig. 4 is a chart drawn for both 60 cycles and 25 cycles and for power factors from 70 per cent to 100 per cent and for sizes of wires from No. 0000 B & S to No. 2 B & S. Curves are shown for standard spacings from 12 in. to 60 in. (Resistance volts and inductance volts per mile of line per ampere are taken from the table found in "Drop in Alternating-Current Lines," by R. D. Mershon.) This chart is printed on a separate sheet as a supplement.

The chart (Fig. 4) can be used to determine either:

A:—The size of wire for a given line drop or line regulation.

B:—The size of wire for a given watt loss in the line.

C:—The line drop and the watt loss for given sizes of wires.

D:—The effect on the line drop of the power factor of load with given sizes of wires.

As a matter of fact, any problem in line transmission, in whatever aspect the problem may be presented, can be solved with the use of this chart.

USES OF THE CHART.

(A) When the line drop expressed in per cent of the e.m.f. delivered is given, to find the size of the wires:

Calculate the line drop in volts per mile of line per ampere, and for the assumed power factor of load on the line marked cos Φ lay off from the origin (point *O*) a length equal to this line drop in volts per mile per ampere. (The dotted circles drawn from point *O* give, on the different cos Φ lines, different values of volts per mile per ampere and this distance can thus be ascertained by inspection.)

At this point place a set square making a line at right angles to the cos Φ line chosen above and its intersection with the curve on the chart for the spacing assumed will give the nearest size of wire to be used.

(B) When the watt loss in the line expressed in per cent of the delivered power is given, to find the size of wire:

Calculate the volt loss per mile of line per ampere. This value is equal to the resistance volts per mile per ampere, and is measured along the base of the chart. Following the ordinate from this point to the interesection with the curves, the size of wire will be ascertained.

(C) When the size of wire and spacing is given, to find the line drop and line loss for a given power factor:

From the point on the chart corresponding to the size of wire at the spacing given, place a set square at right angles to the power factor line. The length cut off on the power factor line from point *O* represents to scale the line drop per ampere per mile of line. Multiplying this value by the amperes in the line and by the length of the line in miles, the value of the total line drop will be obtained, and this value can be expressed as a percentage of the e.m.f. delivered, thus giving the per cent regulation.

To determine the line loss, follow the ordinate from the point on the chart representing the given size of wire and the spacing to the base line, the length cut off from the point *O* on the line representing resistance volts, gives the resistance volts per ampere per mile of line. Multiplying this value by the amperes in the line and the length of line in miles the volts lost are obtained and can be expressed as a per cent of the received voltage.

The above is thought to be sufficient to explain the construction and use of this chart, but a few examples may be of value.

ILLUSTRATION OF THE USE OF THE CHART.

Example 1. Line drop assumed. Find size of wire. (Single-phase.)

Power to be delivered, kilowatts	250
E.m.f. at receiver, volts	2,000
Distance of transmission, feet	10,000
Power factor of load, per cent	80
Frequency, cycles	60
Distance apart of wires, inches	18

Line drop allowed: 23 per cent of received voltage.
Find the size of wires.

(a) Calculation of line drop per mile per ampere.

$$\frac{250 \text{ kw}}{0.8} = 312.5 \text{ kva.}$$

Line current at 2000 volts $\frac{312{,}500}{2000} = 156.25$ amp.

Line drop 23 per cent of 2000 volts = 460 volts.

Line drop per mile per amp $\frac{460 \times 5280}{10{,}000} \times \frac{1}{156.25} = 1.55$ volts.

(b) On the chart place a set square on the 80 per cent power factor line where the above value of 1.55 volts is shown, the intersection of the set square with the 18-in. spacing 60-cycle curve will give a size of wire of No. 0 B & S exactly.

Working this problem backward analytically, to check the above, and using the resistance volts and reactance volts per ampere for No. 0 B. & S. wires—namely, 0.197 and 0.228 ohm respectively, the line drop or regulation volts will be found equal to 460—that is, 23 per cent of the receiver voltage.

Example 2. Line drop assumed, to find the size of wires — Φ. (Three-phase.)

A three-wire, three-phase transmission of which the conductors are symmetrically related may, so far as watt loss and line drop are concerned, be replaced by two single-phase circuits having no inductive interaction and identical with the three-phase line as to size, wire and distance between wires.

To calculate a three-phase transmission, calculate a single-phase circuit to carry one-half the load at the same voltage. The three-phase transmission will require three wires of the size and distance between centers determined for the single-phase system.

Power to be delivered (three-phase), horse-power	4,000
E.m.f. at receiver, volts	40,000
Distance of transmission, miles	85
Power factor of load, per cent	80
Frequency, cycles	60
Distance apart of wires, inches	60
Line drop, per cent	20

Find the size of wires.

(a) *Calculation of line drop per mile of line per ampere.*

$$\frac{4000 \times 746}{0.8 \times 1000} = 3730 \text{ kva.}$$

Single-phase equivalent load = 1865 kva.

Current at 40,000 volts $= \frac{1{,}865{,}000}{40{,}000} = 46.6$ amp.

Line drop allowed $40{,}000 \times 20 = 8000$ volts.

$$\text{Drop per line-mile per amp} = \frac{8000}{85} \times \frac{1}{46.6} = 2.02 \text{ volts.}$$

(b) On the chart place a set square on the 80 per cent power factor line where the above value of 2.02 volts is shown the interesction of the set square with the 60-in. (60 cycle) spacing curve gives approximately No. 1 as the size of wire.

Example 3. Given the line loss, find the size of wire and also the per cent regulation. (Three-phase.)

Power delivered (three-phase), kilowatts	4,300
E.m.f. at receiver, volts	30,000
Distance of transmission, miles	27
Power factor of load, per cent	70
Frequency cycles	25
Line loss, per cent of power delivered	10

Find size of wire for 24-in. spacing, also the percent regulation.

(a) Calculation of resistance volts drop per mile of line per ampere.

$$\frac{1}{2} \text{ of } \frac{4300 \times 1000}{0.70 \times 30{,}000} = 102.4 \text{ equivalent single-phase current.}$$

Resistance volts loss for 10 per cent line loss = 30,000 × 10 = 3000 volts.

Resistance volts loss per ampere per mile of line

$$\frac{3000}{27} \times \frac{1}{102.4} = 1.085 \text{ volts.}$$

(b) On the chart find 1.085 on the base line marked resistance volts per mile per ampere, and vertically on the 24-in. spacing for 25 cycles the size of wire is found to be approximately No. 0 B & S.

(c) To find the line drop. On the chart place the set square from No. 0 B & S on the 25-cycle curve 24-in. spacing at right angles to the cos $\Phi = 70$ line, the regulation e.m.f. = 1.11 volts per mile per ampere.

Calculation of line drop:

1.11 volts per mile per ampere × 27 miles × 102.4 = 3070.

$$\text{Regulation per cent} = \frac{3070}{30{,}000} = 10.2.$$

High-Potential Underground Transmission in Boston.

At the regular monthly meeting of the Boston branch of the American Institute of Electrical Engineers, held on Nov. 18, the A. I. E. E. paper on "High-Potential Underground Transmission," by Messrs. Junkersfeld and Schweitzer, was abstracted by Mr. L. L. Elden, electrical superintendent of the Boston Edison Company. Mr. Elden supplemented the paper with a large number of additions and comments relative to the operation of the Edison system in Boston, which are reproduced in abstract as follows, omitting extended reference to the original paper:

The principal source of alternating current in Boston is the L Street station in South Boston, from which radiate 22 transmission lines at 2300 volts, 4600 volts or 6600 volts. These lines, including 29 others between substations, comprise about 120 miles of underground cable and 100 miles of overhead lines and serve 22 substations. A general diagram of the Edison high-tension system is shown herewith. In all but one case at least two transmission lines are provided for each substation, different routes being frequently utilized. The load is supplied by 37,000 kw of machinery, the largest unit being an 8000-kw turbine. If 8000-kw units are used in the future extension of the L Street station, the aggregate normal load will be 100,000 kw.

In the Boston Edison distribution system both radial tandem and ring combinations of lines are used, but the latter is employed only in emergencies. One of the most serious operating problems is the proper adjustment of the automatic relays for the protection of the underground cables, generating and substation apparatus. The 6600-volt busbars are connected to the turbo-generators without automatic switches. Mr. Elden illustrates a typical transmission line supplying current to a direct-current station in the city proper. The lines were 4-0, and are tested to about three times their current rating with two seconds time on the time-limit relay. Owing to the substation conditions, the adjustment is reduced to one-half second at the latter point, and all transformers or converting apparatus taken off the substation are tested at about three times the motor-generator amperes for instantaneous tripping, so that trouble with this apparatus never disturbs the transmission-line circuit-breakers. The same equipment and adjustment are used in the alternating-current substations. In a typical case the adjustment is reduced to 400 amp one second between the plant and the first substation. From here to the next substation the amperes are reduced, leaving the time the same. At the next substation the time is reduced as well as the amperes, say, to ¾ second, and so on, trying to prevent the interruption of the larger capacity equipment by the failure of smaller apparatus. The standard transmission cable used by the Boston company is No. 4-0 paper-insulated cable with 7/32 insulation over all, with ⅛-in. lead sheath guaranteed for operation at 15,000 volts. The Boston company did not commence to use 6600-volt cable until 1902, although 2300-4600-volt cable had been in use since 1898. The early experience in Chicago and elsewhere showed the necessity for avoiding sharp bends and making splices with extreme care.

The standard end-bell consists of a spun brass shell to which the lead sheath of the cable is solidly connected by a wiped lead joint. The outer wrapping of the insulation is allowed to project through the base of the bell for a few inches and is then cut away to permit the separation of the conductors for jointing to outside wires. Hot paraffin compound is then poured into the bell to seal up and protect the joints. The Boston Edison Company has had general success with paraffin so far. The protection given to cables in manholes is somewhat different from the method used in Chicago. In Boston all such cables are securely wrapped with asbestos tape of sufficient thickness to withstand severe applications of fire from other burning cables, a plan that has been satisfactory up to date. Semi-annual potential tests were made at the beginning of the company's high-tension cable construction, but were discontinued as the system became larger. The danger of accident from these frequent high-potential applications was thought to be too great to justify the tests. Testing is now limited to new, altered or repaired cable, which, before being put into service, are subjected to a test of double working voltage for one minute. The Boston tests have up to the present been limited to insulation tests.

When the relative station loads and the size of the cable systems are considered, the Boston company probably suffers less from severe strains on the cables than either the New York or Chicago companies. Only one occurrence has taken place in the Boston system during the entire period of 6600-volt operation which has indicated a surge. A ground was caused by a rat on an oil switch at an alternating-current substation about seven miles from L Street. The ground was immediately indicated at the power plant, but before the line affected could be located, a short-circuit occurred, throwing out the automatic oil switches on both the lines supplying the substation. The lines were instantly restored to service and continued to operate in a normal manner. At the substation it was found that a short circuit had occurred at the terminals of the switch in the next cell on the duplicate line, which was alive but not connected to any of the apparatus in the substation. The current jumped a space of about 7 in. in open air by a circuitous route to reach contacts on top of the switch, which were enclosed in tall porcelain protectors, the arc later spreading to the bus leads and short-circuiting the other line in this manner. The pressure required to make such a jump is purely problematical, since tests on this switch showed no evidence of

breakdown up to 30,000 volts between terminals or to the frame. The lightning arresters also failed to indicate any passage of current to ground or between phases. About a week later a ground was indicated on one of these cables about three miles from the substation, and a pinhole puncture was found through both lead and paper insulation. This was undoubtedly made at the time of the short-circuit at the station, but was of such high resistance that considerable time was required to complete the permanent breakdown of the cable insulation.

Mr. Elden then discussed the high equipment capacity of substations where motor-generators have replaced engine-driven machinery, showing that in some cases if steam-driven units were used the limitations of head room would greatly reduce the available equipment, while in a commercial building installation the company concentrates from four to six times as much

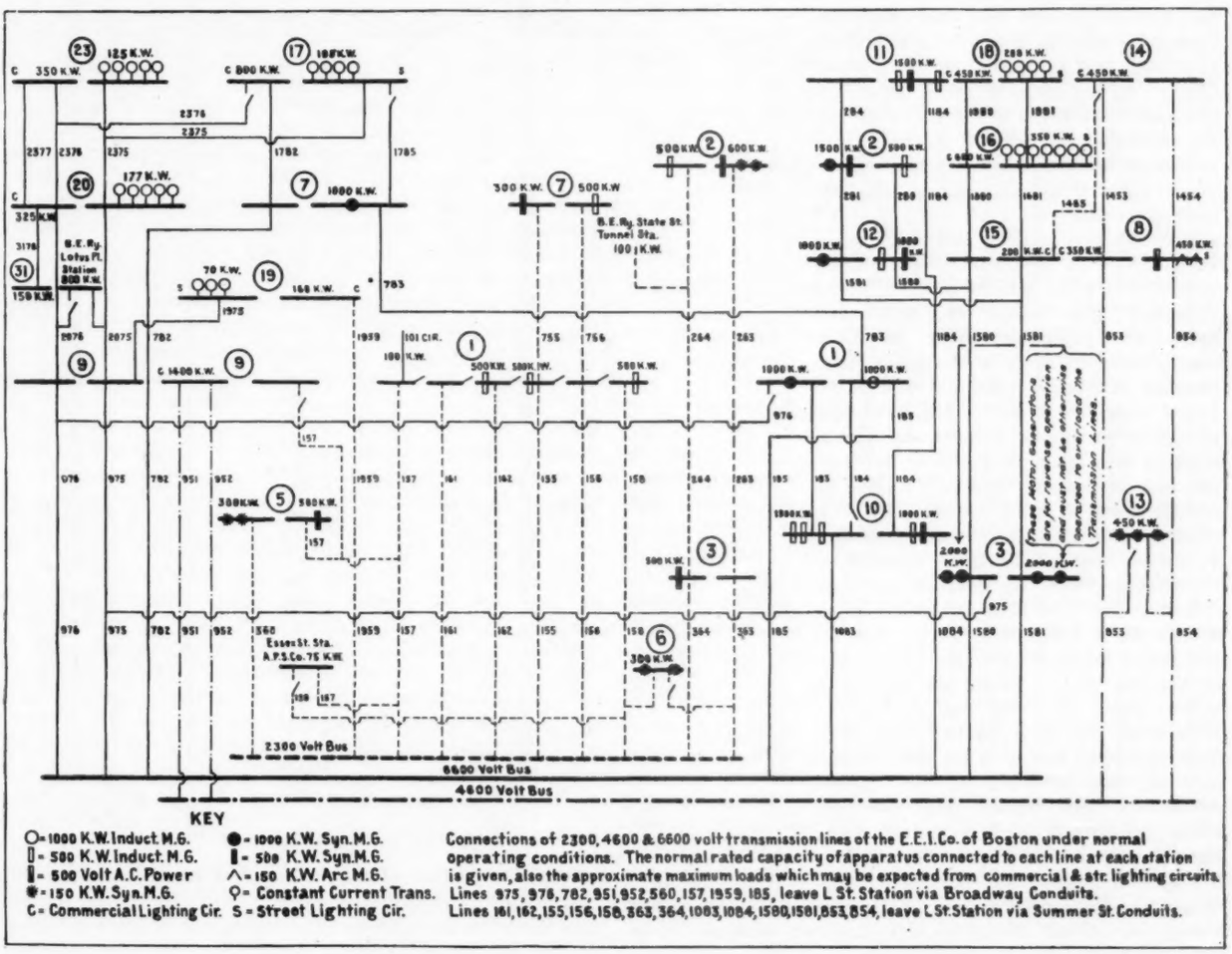

2300 Volt Bus
6600 Volt Bus
4600 Volt Bus
KEY
○= 1000 K.W. Induct. M.G.
●= 1000 K.W. Syn. M.G.
▯= 500 K.W. Induct. M.G.
▮= 500 K.W. Syn. M.G.
▮= 500 Volt A.C. Power
^= 150 K.W. Arc M.G.
✱= 150 K.W. Syn. M.G.
♀= Constant Current Trans.
C= Commercial Lighting Cir.
S= Street Lighting Cir.
Connections of 2300, 4600 & 6600 volt transmission lines of the E.E.I.Co. of Boston under normal operating conditions. The normal rated capacity of apparatus connected to each line at each station is given, also the approximate maximum loads which may be expected from commercial & str. lighting circuits.
Lines 975, 976, 782, 951, 952, 560, 157, 1959, 185, leave L St. Station via Broadway Conduits.
Lines 161, 162, 155, 156, 158, 363, 364, 1083, 1084, 1580, 1581, 853, 854, leave L St. Station via Summer St. Conduits.

DIAGRAM OF BOSTON EDISON COMPANY'S HIGH-TENSION SYSTEM.

equipment as could be installed with engine-driven units. In one 1200-kw station that has been superseded by substation equipment, the space taken up at one end of the station for considerably more than 1200 kw did not exceed the area used for one single 300-kw generating unit.

In the discussion Mr. Elden stated that the failures in the transmission system are the smallest items of disturbance that the company has. The overhead system gives 10 times as much trouble as the cable system, and the cable troubles occurring have largely happened in the cases of cables newly installed. The manufacturers in six of the cases have made the cable good, as having been undoubtedly defective. In the other two cases, which were due to mechanical injury, they were not held responsible. The matter of cable trouble lies largely in the load which is attempted for transmission over any single cable. At 6600 volts the top load is held to be 250 amp. The shutting off or disturbance caused by the loss of a single cable line may result in affecting a number of substations under the radial system of operation, but if the company attempted to protect that phase by having all switches closed in all the substations, it could not get clear without a worse disturbance. As it is now, the duplicate line stands ready for business, and the operator, if he does not get his current shortly, avails himself of the duplicate line and restores the original conditions as soon as possible. The cable troubles are small after the cables are seasoned.

Mr. M. V. Ayres, electrical engineer of the Boston & Worcester Street Railway, then discussed the successful operation of three-phase, lead-covered, 13,200-volt cable on the lines of his company for an overhead section of about 2¼ miles. In one case the lead sheath was grounded by a broken trolley wire, but the cable did not break down until the pole carrying it had been on fire fully 15 minutes. It is surprising how many slight injuries a cable will stand without failure. Prof. D. C. Jackson, of the Massachusetts Institute of Technology, outlined the efforts of the Commonwealth Company of Chicago to command all the power business of the city, pointed out the remarkable development in station output now illustrated by the large Edison systems, and urged the need of more analytical studies of the insulation problem, with special commendation of the oscillograph as a commercial instrument. Mr. N. J. Neill emphasized the effect of seasoning on cable reliability and pointed out the importance of carefully studying the problem of lightning protection. He did not think it wise to impose severe excess voltage tests on cables. He felt that the strength of the disturbance can be reasonably well examined by spark gap tests. Mr. Elden then stated that the relays used in Boston

are giving on the whole very satisfactory service, although they require frequent adjustment. The bellows type is used. Mr. G. W. Palmer, electrical engineer of the Boston & Northern and Old Colony Street Railway Companies, cited five years' successful use of 13,200-volt cable transmission on the Old Colony system, there having been not a single instance of disturbance of operation since the cable was installed.

The meeting was closed by Mr. Elden, who emphasized the amount of power now behind defective cables when anything goes wrong, and the severe mechanical effects of heavy short circuits in cable runs. The New York company is at present operating the largest load of any company in the world, having at the peak load 120,000 kw connected and operating on one bus—an incredible load to concentrate on a short-circuit. As the company grows some steps will have to be taken in the future to limit the amount of current. A device has been developed by the New York company to detect cable troubles, and this has been quite successful in all but four cases in a year's operation enabling the cable to be selected and get it disconnected from the system before the trouble occurred. This is a long step toward the satisfactory operation of any cable system. Mr. Elden was inclined to favor a reasonable high-potential test before putting a new or repaired cable into service. Some arranged to apply a 30-minute test at double normal working pressure after the cable has been installed, but this test is never repeated on a cable unless a failure occurs. The Chicago company operates a motor-generator at variable voltage, raising the potential on the defective cable very gradually until the test limit has been reached. After letting it soak for a few minutes they pull it off and throw the cable upon the system, and in but one or two cases has the cable broken down after the test, due to the fault which was being repaired. The New York company uses a static transformer, but does not, according to Mr. Elden's recollection, run higher than one-third above the normal working voltage. The Boston company is thinking of duplicating this general type of test, bearing in mind that the manufacturers do not approve a continued application of high excess voltage on account of the danger they feel thus is thrown upon the permanence of the insulation.

The vertical line on the extreme right, reading downward, is the per cent core loss. On the fifth vertical line from the right, reading downward, is the total per cent loss. The figures indicating this loss are placed on the left side of this line. This

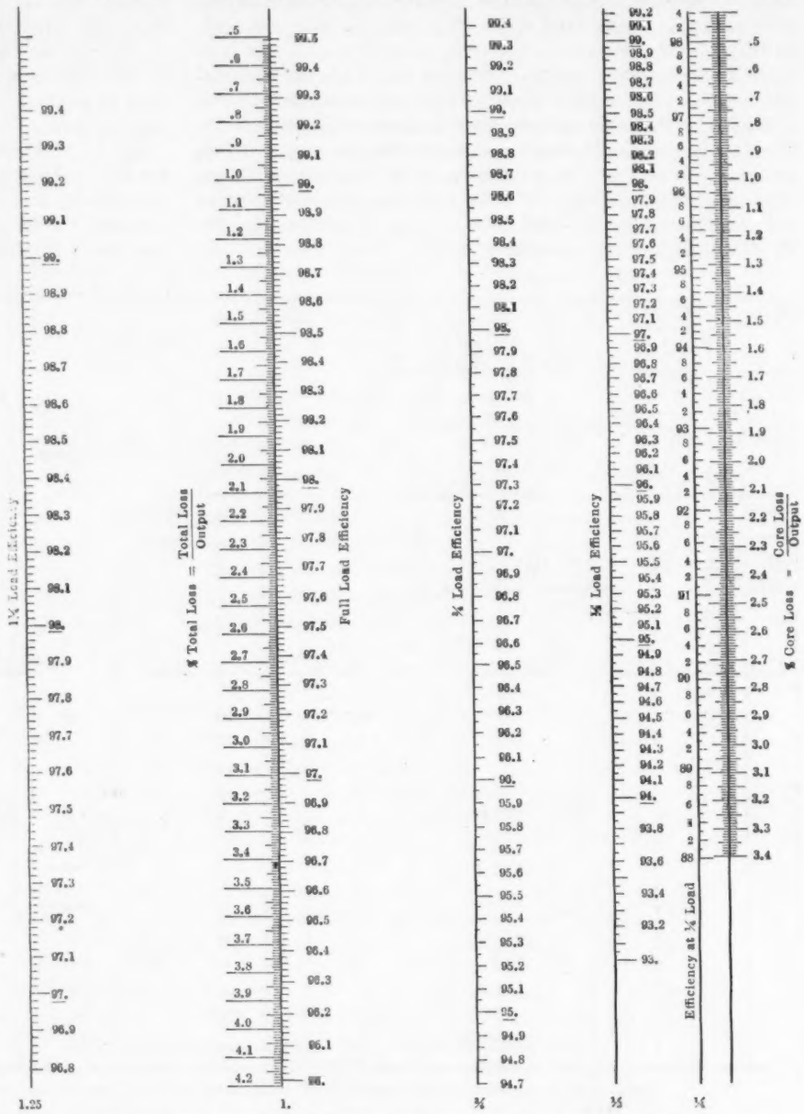


CHART FOR SHOWING EFFICIENCIES AND LOSSES OF TRANSFORMERS.

total loss is the sum of the per cent core loss and the per cent copper loss. In order to simplify the use of the chart the per cent losses are given in terms of the output or kilowatt rating of the transformer. On the second line from the right are efficiencies at one-quarter load, and on the third line from the right are the efficiencies at half-load; on the fourth line from the right are the efficiencies at three-quarter-load; on the fifth line from the right are the efficiencies at full-load, as indicated by figures on the right side of this line; on the sixth line from the right, or the line at the extreme left of the chart, are the efficiencies at 1¼-load.

To read efficiencies with any given losses use must be made of a straight-edge about 1½ times as long as the chart is wide. This straight-edge should be laid on the chart so as to intersect the vertical line representing the per cent core loss at the given per cent and at the same time to intersect the vertical line representing the total loss at the given per cent. When this setting is made the straight-edge will intersect the other vertical lines at the efficiencies for loads which they represent. A substitute for a straight-edge is a thin, transparent piece of celluloid about 1 in. wide, and of the required length, having a scratch down the center. For obvious reasons this scratch

Chart for Determining the Efficiencies of Transformers.

By Henry C. Stanley.

The accompanying chart has been devised for determining the efficiencies of transformers at one-quarter-load intervals from one-quarter load to 1¼ load. It enables one to ascertain the efficiency at these loads when the constant core loss and the copper loss at full-load are known; when the efficiencies are known for two loads the losses can be ascertained at once by use of the chart.

The chart consists of five vertical scales for showing efficiencies and two vertical scales for the losses. For each transformer there exists a relation between the points on these seven scales, such that when any two points are located the other five may be found immediately.

should be on the side next to the chart; that is, on the under side of the celluloid. The most convenient way to set the celluloid is to stick a pin through the scratch on one end of the strip and place the point of a pin at any given per cent core loss. With the strip pivoted at this point it can readily be swung around to any required per cent total loss, after which the efficiencies can be read where the scratch intersects the different vertical lines.

As intimated above, an important feature of the chart is that the straight-edge can be set to any two given efficiencies for any two loads whatsoever, on which setting the efficiencies at all other loads can be directly read, as can also the per cent core loss and the total per cent loss. The chart has proved a great time saver in the above respect in that it is a rather difficult operation to determine the per cent core loss and the per cent copper loss for any given efficiencies.

Rheostatic Starters for Induction Motors.

BY DR. BENJ. F. BAILEY.

The principal defect of squirrel-cage induction motors, as compared with other types of alternating- and direct-current motors, is lack of starting torque. At best, most induction motors of this type will develop not to exceed about twice normal synchronous full-load torque, and to do this require from five to seven times normal full-load current. The shunt-wound direct-current motor, on the other hand, will develop double full-load torque, with approximately double full-load current, while the series-wound direct-current motors will develop the same torque with approximately 1.5 times the full-load current. In the induction motor, therefore, there is a fundamental difficulty to be overcome, and a consideration of the best starting devices is of importance.

The designer can, to a certain extent, control the starting torque. For a uniform rotating magnetic field, the torque is proportional to the square of the secondary current times the secondary resistance. The secondary current is approximately proportional to the primary current and, for reasonably small variations of secondary resistance, the current taken at starting will be practically the same, and the starting effort produced will be approximately proportional to the square of the primary current times the resistance of the secondary. Consequently, the starting torque is nearly proportional to the secondary resistance. Unfortunately, however, the slip at full-load is also proportional to the resistance of the secondary; consequently, the designer is forced to choose between two evils: high starting torque and great slip and low efficiency, or low starting torque and small slip. The proportions to give these two factors must be decided by the designer from his experience and judgment.

A general tendency of American motor manufacturers is to make the maximum starting torque of the motor connected directly across the line equal to about 175 per cent of the synchronous full-load torque. In starting, it is impracticable to connect large motors directly across the line, both on account of the large current taken, which affects the voltage, and on account of possible injury to a connected apparatus, due to sudden starting.

For reducing the starting current use is made of two kinds of devices, the "compensator or auto-starter" and the rheostatic starter. The "compensator" is an auto-transformer, consisting of either a three-phase transformer or of two V-connected single-phase transformers. They are ordinarily arranged with taps to give approximately 50, 65 and 80 per cent of full-load voltage. The rheostatic type of starter (for the three-phase motor) usually consists of three resistors arranged to be inserted one in each phase at starting, the resistance being gradually decreased in much the same way as the resistance of a direct-current starter is decreased. It is principally to examine the relative effects of the latter two devices that this article is written.

In the first place, it is well to understand clearly the purpose of the starting device used with the induction motor. It is not used to avoid injury to the motor, as in a direct-current installation, because the machine would rarely be damaged by being connected directly across the line. It is, however, true that injury might be caused by this procedure to other apparatus connected to the system. Neither, in general, is the amount of power taken at starting of any great moment, as the rating of the alternator supplying energy to the circuit is ordinarily, though not invariably, much greater than that of the motor. In general, the purpose of the starter is to limit the line current to such a value as not to cause undue fluctuation in the voltage which might affect the lamps or other motors connected on the same circuit.

The great fluctuation in voltage when a squirrel-cage induction motor is started from rest is due not so much to the current taken as to the low power factor. A current that is in time-phase with the e.m.f. reduces the voltage of the circuit very little. When, however, the current lags 90 time-degrees behind the e.m.f., the reduction of the voltage is much more marked. In the case of the generator, the current reaches its maximum at such a time that the ampere-turns of the armature directly oppose those of the field coils; consequently, the voltage is greatly reduced, unless the machine has an exceptionally large ratio of field-circuit to armature-circuit ampere-turns. In other words, the regulation of an alternator on low power factor is poor. The same thing applies to the transformer and line, the drop in voltage of the transformer being usually four or five times as great for the same current at zero power factor as at unity power factor. If, therefore, the current which the induction motor takes at starting is considered as divided into two components, one in time-phase with the e.m.f., the other lagging 90 time-degrees behind it, the one in phase reduces the voltage but little, while the component lagging 90 degrees reduces it very greatly.

It can easily be shown that the wattless component of the starting current is the same whether an auto-starter is used or whether the motor is started by resistance alone. It is evident, without proof, that the value of the volt-amperes received by the motor at starting will depend solely upon the voltage impressed upon its terminals. The auto-starter must obtain from the line this value of volt-amperes and in addition thereto the wattless volt-amperes for providing its own magnetization and the power volt-amperes for overcoming its own losses. When the rheostatic starter is used there must be supplied from the line the volt-amperes taken by the motor and also the power volt-amperes consumed in the rheostatic starter.

Hence, it is seen that the component of the current actually reaching the motor, which causes the reduction in voltage when the motor is started, is the same whether an auto-starter or a rheostatic starter is used. The case is, however, a little worse with the auto-starter than this statement would indicate. Auto-starters are usually built up with a number of coils slipped over the same leg of the transformer and taps are taken off over a certain number of turns. This arrangement leaves all of the "primary" turns at one end of the transformer coil, and the "secondary" turns at the other end. The conditions are, consequently, the best possible for a large leakage and the auto-starter itself introduces a considerable additional wattless component of current. In other words, it requires a considerable magnetizing component of current to supply its own magnetic leakage flux. It is, therefore, a fact that of the two starters the auto-starter requires a larger wattless component of current from the line than does the rheostatic starter, and consequently the fluctuation in voltage is fully as great with the auto-starter as with the rheostatic starter. It should be noted that the current which actually reaches the motor and consequently the starting torque are precisely the same in the two cases.

There is another respect in which the rheostatic starter is superior to the auto-starter. As soon as the motor gets under way the current becomes less; this change, of course, reduces the *IR* drop through the rheostat and consequently a higher voltage is applied to the motor. Thus either less current will be

required in the motor or a greater torque will be available than if an auto-starter were in use. With the auto-starter the starting voltage and the maximum available torque remain practically constant until the motor is connected directly to the line. In starting certain loads, such as a fan, where the torque required increases somewhat with the speed, or even where it remains constant, this is a decided advantage in favor of the rheostatic starter. For a given value of starting current, the motor will attain a higher speed with the resistance starter than it would with an auto-starter and the circuit is not opened during starting. This avoids burning the contacts. The disturbance, when the motor is finally thrown on the line, is, therefore, less. Moreover, it is more easily feasible to provide these starters with intermediate steps; in fact, they are very rarely, if ever, built any other way, whereas the tendency with auto-starters is to provide only two steps, the starting position and full-voltage running position.

The resistor starter, of course, takes more power than does the auto-starter. In starting very large motors the power required may be a considerable factor, due to the generator and prime mover being, in many cases, of little, if any, greater rating than the motor. In such cases the auto-starter undoubtedly has the advantage. It should be noted, however, that this advantage is greatest when it is least needed; that is, when the motor starts with only light torque and consequently a considerable reduction in voltage can be made by the starter. If taps giving 85 per cent of the full line voltage are used the motor with auto-starter receives 85 per cent as much current as it would if connected directly across the line, but it takes only 72 per cent as much current or power from the supply system. With the rheostatic starter the current at the same voltage would be 85 per cent, so that the volt-amperes saved by the auto-starter over the value required for the rheostatic starter would amount to not more than about 33 per cent.

To test the above conclusions, a 20-hp, 220-volt, three-phase, 60-cycle, squirrel-cage induction motor was connected with both a rheostatic starter and an auto-transformer starter in series. Either starter could be set in the full running position at will, thus short-circuiting it. Considerable care was taken so to select the two starters that the voltage applied to the motor at the instant of starting would be the same whichever was used. The energy was obtained from a commercial circuit, fed from a large generating station; the transformers were ample in size, having a total rating of about 40 kw.

Five readings which were taken gave the following averages:

Volts on line.	Rheostatic starter.	Auto-transformer starter.
Motor off	230	229
Volts line-starting	212	210.7
Volts motor	97.8	98.5
Drop in voltage	18	18.3

It will be noted that the drop with the auto-transformer starter was a trifle greater than that with the rheostatic starter; however, the current in the motor was also slightly more. From this test it appears that the two starters were on an equality as regards disturbance to the line voltage.

In addition to the above a number of other trials were made under various conditions. The drop in voltage at the instant of connecting the motor was found to be the same in the two cases.

SUMMARY.

The rheostatic starter is much cheaper than the auto-starter, but requires in starting more current from the line in proportion to the ratio of the voltages of the auto-transformer. The power used would probably not amount to more than 15 per cent. This difference decreases as soon as the motor gets under way. The wattless component of the line current required by the motor is somewhat less with the rheostatic starter, consequently the disturbance to the line voltage, on attempting to start the motor by the two methods, is approximately the same. The starting can be made somewhat more gradual with the rheostatic starter since it is feasible to introduce a number of contacts, and the disturbance on finally connecting the motor to the line, even though only two contacts are used, is less than with the auto-starter. Since the rheostatic starter is cheaper and gives equally good results as regards regulation, it would seem as though it should be preferred for most motors, at least in the small and medium sizes.

Arc Lamps in 25-Cycle Service.

By H. C. Reagan.

In view of the general belief that arc lamps cannot be operated at a frequency lower than 40 cycles per second, and because difficulty has been experienced in designing arc lamps for 25 cycles, it is believed that an account of results obtained with arc lamps actually used on a 25-cycle system will be of general interest.

In addition to the well-recognized fluctuation in the light at the low frequency, the ordinary arc lamp used at 25-cycles exhibits an excessive pumping action of the lamp mechanism which has a destructive effect upon the electrodes and causes a disagreeable chatter. This action is attributable to the low rate of change in the magnetizing force of the solenoids upon the plungers.

The mechanical and magnetic difficulties incident to these actions have been overcome in the lamp above referred to, and some of these have been in use for several months at 25 cycles by a certain single-phase railway for head-lanterns on cars and for illuminating the generating station, car houses and yards.

In these lamps the mechanism controlling the electrode is so constructed that it will move up or down in a magnetic field according to the mean value of the current, but will not cause the electrode to vibrate in unison with the low-frequency current. The plungers float in the varying magnetic field and do not come in contact with any portion of the mechanism, so that hammering is avoided. The mechanism can be employed with electrodes placed one above the other or side by side, as may be desired.

Although a flicker is noticeable when the lamp is viewed directly, the objects illuminated by the lamp do not show any effect of flicker. The passengers have experienced no difficulty in reading newspapers and written matter at the station. Moreover, no wavering of light was noticeable when the ground was covered with snow. Observations made with the lamp in a room having white walls have not shown any flicker of the shadows cast by objects upon the walls. No difficulty has been experienced by workmen in using tools under 25-cycle arc-lamp illumination.

The general use of 25-cycle arc lamps would result in the elimination of frequency-changing apparatus when energy is obtained from long-distance transmission circuits.

Incidentally it may be mentioned that the cars upon which the 25-cycle head-lamps are used operate over direct-current circuits at the terminals of the road. The lamps are so constructed as to be applicable to both direct-current and alternating-current service. The change from one type of current to the other is accomplished automatically without any attention on the part of the motorman.

Forced Draft for Steam Boilers.—III.

By W. H. Wakeman.

The principle by which air is sent into the ash pit by the direct application of steam jets should be considered in connection with forced draft. While the steam jet may not be the most economical method that can be used for this purpose, so far as the consumption of steam is concerned, still, on account of its low first cost, ease of application and flexibility in operation it is extensively used. If natural draft has always been used in a plant, and the manager or the chief engineer desires to investigate the possible results of using forced draft, it is a good idea to fit up one boiler with steam jet apparatus and give it a trial. If its operation is satisfactory it may be applied to other boilers, or if not fully approved it may be

modified to suit conditions. In case it proves objectionable it is an easy matter to discontinue its use, and the experiment will usually be worth all that it costs.

Fig. 1 illustrates a wooden box fitted into the ash pit doorway of a tubular boiler for the purpose of making several experiments by means of the steam pipes shown inside of it. The feed pipe is ¾ in. in diameter, but the upper and lower outlets are made of ½-in. pipe. The horizontal pipes are capped at the right-hand, and each of them contains 15 holes

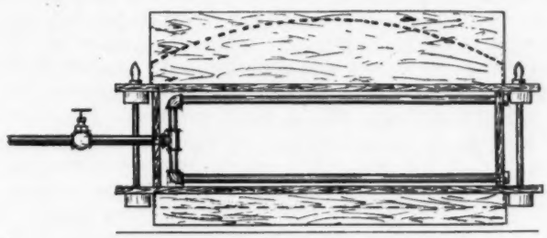


FIG. 1.—WOODEN BOX FITTED IN ASH-PIT DOOR.

5/32 in. in diameter. Fig. 2 is a plan of this box as it appeared when steam was coming out of these holes.

During the first trial this box was only 7¼ in. deep, consequently the blast was not strong because the steam jets spread into the open ash pit too soon for good results. When this depth was increased to 14½ in. the result was much better, as the column of air was confined within these limits for a longer time and hence was compelled to move forward. When the depth was made 21¾ in. the result was no better. Originally

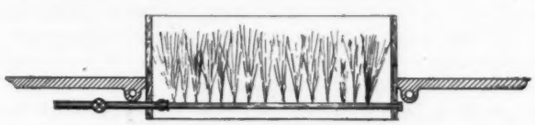


FIG. 2.—PLAN OF BOX, WITH STEAM JETS.

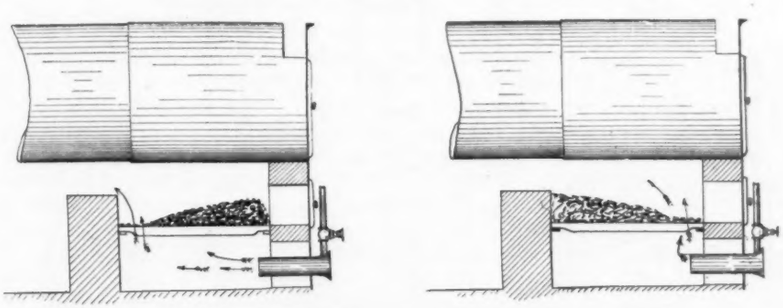
the box was 7 in. high and 30 in. long, thus leaving about 4 in. between the horizontal pipes, hence when the jets were turned to blow parallel to the top and bottom boards there was too much space that was not fully covered. Turning the upper row downward and the lower row upward until they mingled at about 18 in. from the pipes made a slight improvement. The nipples which are shown in the reducing tee were taken out, shorter ones substituted until the ells were practically in touch with the tee, and the box was reduced accordingly, making it about 4½ in. high. This created a stronger draft, although the inlet for air was much smaller than before. Each alternate hole was then stopped with a brass plug, and steam again admitted. As the holes were 2 in. apart before, they were 4 in. now, and this proved to be too far, as it allowed air to blow back between them. The consumption of steam was reduced 50 per cent, but it was not an improvement when all points were considered.

During a portion of this trial the boiler was cut out, or, in other words, the outlet valve for steam was closed, thus isolating it from others that discharge into the common header when the whole plant is in service. This was done for the purpose of observing the effect of allowing holes to burn through the fire. These were not very large, as no effort was made to create abnormal conditions. It is a well-known fact that thin spots or holes in a fire greatly reduces its efficiency because cool air rushes through them, following the course which presents the least resistance. However, it may be a surprise to learn that by allowing the fire to burn thin near the bridge-wall, as illustrated in Fig. 3, the steam pressure was lowered 5 lb. in a few minutes. In this case the cool air rushed almost directly up against the boiler as it passed over the bridge-wall, still the same conditions are frequently found in practice. When a fire burns low in front, as shown in Fig. 4, the effect is not so bad, because the air passes over the fire and assists combustion, especially where bituminous coal is used. In a certain plant that the writer is familiar with, the rule is to allow 4 in. of the front to be practically bare, thus allowing air to come through freely. Bituminous coal is used and only natural draft is employed. These points are mentioned because it could not be done with screenings burned with a strong forced draft.

It is much better to purchase steam jet apparatus from parties who have conducted experiments and demonstrated correct methods for economy of steam consumption and best results generally, than to use makeshifts that could not be sold in the open market. Although home-made apparatus appears cheap, usually because only a small portion of the real cost is considered, it is really very costly in many cases, and very unsatisfactory when the results secured are carefully considered.

Fig. 5 illustrates a series of small steam jets that are scientifically arranged so as to force a maximum quantity of air with a minimum of steam. The tube through which air is drawn and forced is long and when in full operation it is apparently filed with steam, although a portion of the rushing mixture is air, therefore no opportunity is offered for a back action that allows any part of the intended effect to be lost.

Fig. 6 shows one of these blowers in operation, taking air from a point near the boiler room floor. No way has been discovered for preventing a disagreeable noise with this kind of blower, caused by steam issuing from small orifices and a large quantity of air rushing at high speed through a small space; but where this noise is not objectionable it gives satisfactory results, as it creates a very strong draft. If it is practical to locate a blower of this kind in the side wall of a boiler setting, it is a good idea so to place it, but where several boilers are set in a battery the side walls are not available for this service. It is possible to locate the blower in the front



FIGS. 3 AND 4.—STEAM JET APPLIED TO ASH PIT.

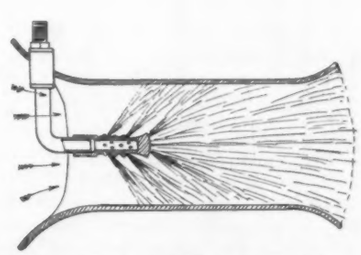


FIG. 5.—DETAIL OF STEAM-JET BLOWER.

wall, but it is not always convenient. In such a case it may be put in one of the ash pit doors, as illustrated in Fig. 7. The door can be opened without shutting off steam if desired, but it is customary to shut the upper valve, as the blast is not wanted when this door is open. Three swing joints are shown in the illustration, constituting a kind of universal joint which allows the door to be opened at pleasure without removing the piping. The lower valve is used to regulate the blast when its full effect is not desired.

Advocates of forced draft for burning the various kinds of

small anthracite coal always claim that the installation of this system makes it unnecessary to build an expensive chimney, but a note of warning should be sounded along this line, as there is danger of wasting money in erecting a chimney that will not be satisfactory in service. Not far from the writer's office there is a plant where buckwheat coal is used almost exclusively for making steam to drive the machinery. Even when the boilers are carrying a normal load, fire comes out all around the furnace doors, and much of the products of combustion are delivered into the boiler room instead of going into the chimney, which is round in form, 4 ft. 6 in. in diameter and 60 ft. high, and is located near the boilers. The grates are 6 ft. 9 in. wide and 8 ft. long, therefore each furnace contains 54 sq. ft. of surface, and as there are three of them the total grate surface is 162 sq. ft. The ratio of stack area to grate surface is 1 to 10. In another plant which has a good natural draft, there is a substantial round chimney 5 ft. in diameter and 75 ft. high. Each furnace has 30.25 sq. ft. of grate and as there are five boilers the total grate surface is 151.25 sq. ft., giving a ratio of 1 to 7.7. When one considers that the latter is sufficient to give satisfactory natural draft, it certainly appears as if the former would take away the smoke and flames, but it does not. It ought to be large enough to give the same ratio, or 5¼ ft. in diameter, and if it were 6 ft. it would be better. The reason for this is that although in the former case the chimney is not intended to create the necessary draft, it was expected to prevent the existing condition of affairs, which is a great nuisance to everybody working in the plant. The volume of air going into these furnaces is too great for the chimney, although two of the furnaces have but 5 per cent of air space in the pin-hole grates, while the third is fitted with another kind that gives 12 per cent. The foregoing is not a theory, but a condition, and the moral is to make the chimney as large for forced draft as it would be for natural conditions. This refers to the diameter and not to the height, but it ought to be high enough to carry the smoke and gases above the surrounding buildings. If the saving made by the adoption of forced draft is as great as its advocates claim, when the daily consumption of fuel is alone considered, it is sufficient to warrant its introduction to places where it has never been used before. It is not necessary to lay special stress on the claim that the first cost of installation is much less.

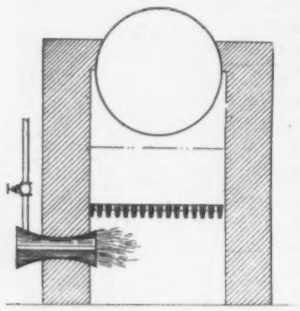
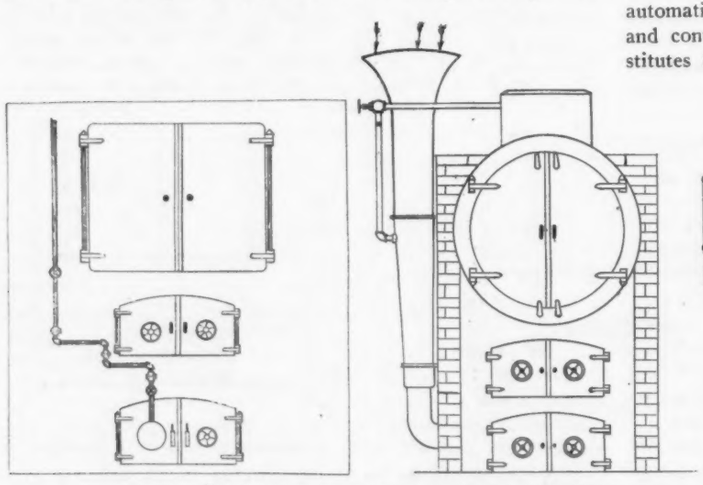


FIG. 6.—BOILER FITTED WITH STEAM-JET BLOWER.

In order to be on the safe side new plants should be built to use natural draft for making steam, then if it becomes necessary or advisable to substitute mechanical draft, difficulties will not arise. On the other hand, if a short chimney is built and forced draft apparatus only is installed, it is not possible to utilize natural draft without building the chimney higher, which is not always practicable, as the foundation may not be sufficient for a much heavier chimney, and other conditions do not always favor the change.

A certain manufacturer who adopted forced draft and low-priced coal several years ago, stated very emphatically that the saving was not as great when all points were considered as the daily reports showed. This was due to the fact that in a few years it was necessary to renew his boiler plant, when otherwise he would not have had this heavy expense to meet, as other plants that are operated less strenuously have lasted much longer and are still in good condition. The nominal saving made in this particular case was more than $100 per week, and if this was not a paying investment where only four boilers were included, it is evident that less saving in other plants will be more unsatisfactory as time passes. All phases of the question should be intelligently considered when these matters are presented, and a decision reached that is based on a knowledge of the fundamental principles involved in connection with those that relate to the superstructure.

Fig. 8 illustrates a device for creating a draft which takes its supply of air from the upper part of the boiler room where ventilation is needed more than at other points as a general rule. Fig. 9 shows the operation of a very ingenious system of forced draft. Steam is taken from the boiler through the pipe 2 to operate an ordinary damper regulator 3 which controls a damper lever in the usual way, thus shutting off the natural draft when the required pressure of steam is secured, and at the same time holding the heated gases in contact with the boiler until the pressure falls enough to open the damper, which is usually about 1 lb. As long as the damper is closed, steam is shut off from the blower, but when the lever 4 is operated by means of the small chain 5, the balanced valve 6 is also opened and admits steam to the blower 7. The steam passes through the pipes shown, which are located in the combustion chamber, and also the superheater 8, and the blast is delivered through the bridge-wall into the ash pit. An improved shaking grate completes the installation, and this enables the fireman to clean the fire without opening the furnace doors. It is claimed that less than 3 per cent of the steam generated is used to operate the blower, owing to the automatic regulation, which prevents a wasteful use of steam and controls the escape of heat to the chimney. This constitutes in reality a balanced draft system, for if a handkerchief is held before the furnace doors it will neither be drawn into the furnace nor blown out by escaping gases and presents ideal conditions so far as preserving boilers from the effects of unequal contraction are concerned, due to drafts of cold air rushing into the furnace when the fire is replenished. If the consumption of steam does not exceed the percentage above named, it is not an expensive method, but such economy cannot be secured by ordinary home-made apparatus.



FIGS. 7 AND 8.—ARRANGEMENT OF STEAM-JET CONNECTIONS.

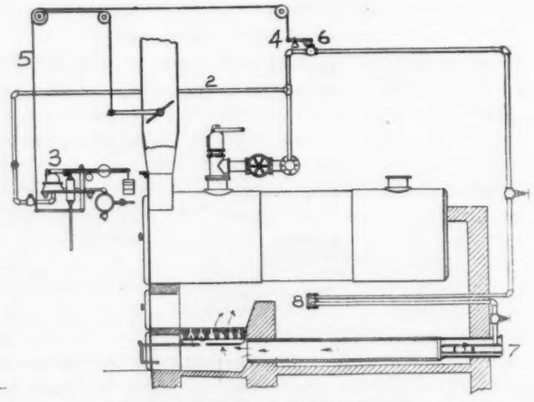


FIG. 9.—SYSTEM OF FORCED DRAFT.

LETTERS ON PRACTICAL SUBJECTS

REVOLVING ELECTRIC SIGNS.

Some of the most striking and attention-arresting electric signs are those which make free use of the commutator or controller for periodically lighting and extinguishing sign lamps. True, the effect may be made very striking, but it is expensive as well. This is particularly the case when the work must be done at considerable speed, and the commutator revolves at a comparatively high rate of speed. Signs are occasionally seen which produce very striking effects of periodic light and darkness without the use of single make or break contact. This effect may be easily produced by mounting the entire sign, or a portion of it, upon pivots, journals or trunnions, and then revolving the mounted portion by means of gearing and a small electric motor, which could be operated by the same energy which lights the sign lamps. The effect of a sign or a portion of a sign, while slowly revolving, is very striking. An ordinary rectangular sign placed horizontally and revolved upon vertical pivots forms a sign which compels attention from one end of its cycle to the other. True, a sign of this kind requires considerable room, but the space necessary may be greatly lessened by placing the axis horizontally and revolving the sign vertically. Indeed, a sign may be arranged in this manner which will revolve most of the time without a motor or any other driving apparatus. The principle of such a sign is the double curved sign now commonly used by barbers. This little striped sign revolves as long as the wind blows and the addition of a few glow lamps and a contact ring and brushes produces one of the most startling signs yet placed before the public. The wind does all the revolving necessary, thus relieving the user of the cost of a motor. This, of course, is bad for the central station, but it will sometimes enable a sign installation to be made where the use and expense of a motor would not be considered. Two or more signs revolving in the same frame, perhaps in different directions and at various rates of speed, form a sign which will compel the attention of the most stolid. When the wind is not blowing, a reliable standing sign is displayed, but when the wind blows good and hard then there is certainly an interesting electric sign to attract the attention of the public.

WILLOUGHBY, OHIO. JAMES F. HOBART.

EFFECT OF SMALL CHIMNEYS.

Many of the small lighting and power plants built years ago with no thought or expectation of greatly increased load, have added to their generating equipment and, in some instances, to their boiler equipment also, without taking the chimney into consideration, and when everything was supposedly provided for, the engineer wonders why steam cannot be kept up to meet the demand of the engines. The writer has found this condition to exist in many small plants where small boilers were replaced by larger boilers and where in consequence of the change the chimney was no longer large enough. The writer has a case in mind where a well-constructed brick stack was built for two 60-hp boilers. Each of the boilers had 62 3-in. tubes, or a tube area of approximately 377 sq. in. It should be evident that the stack must have as much area as the boiler tubes if the heat in the stack were the same as that in the boiler. The heat in the stack, however, is less than that in the boiler, so that the area of the stack could be slightly less than the aggregate area of the tubes if the two were in a vertical position. The writer has found in practice that the area of the stack should be at least 10 per cent more than the area of the flues, so that unless the area of the stack is equal to that of the flues, the boilers might just as well be operated with some of the tubes plugged up. The stack in question was built square with an opening 23 in. x 24 in. No doubt the opening was intended to be 2 ft. square, but the bricklayer made a mistake, so that the actual area of the chimney section was 552 sq. in. The area of the flues of one of the boilers was 377 sq. in. and there being two boilers, the aggregate area of all the flues was 754 sq. in., whereas the area of the stack was less than this. The stack was well built and had walls thick enough to permit an opening 28 in. square; but it was another of those engineering blunders that one finds as a monument to the engineer who did the work. When determining the proper height of the stack, the surroundings must be taken into consideration. A 50-ft. stack surrounded by tall buildings will not draw as well as a stack of the same height standing free in the open. The stack under consideration was 50 ft. high and if one refers to the regular table on stack capacities he will find that a stack with a height of 50 ft. and with a side of 24 in. is rated at 65 hp, assuming 1 hp as equal to 5 lb. of coal burned per hour. The stack in question was slightly smaller than this, so that in reality it was only large enough for a single boiler. This plant operated thus for years with two boilers under fire the greater part of the time, and as a result the combustion was poor and the steam generated low compared with the flue consumption caused by poor combustion and clogged flues. When it was found necessary to add more boilers, the conditions became worse. Two boilers which were capable of generating 200 hp on a low rating were installed before it was discovered that the stack was too small. Reference to a chimney table showed that it required a stack 90 ft. high and with a square side of 35 in. The old stack was torn down and a new one erected. Many other plants are operating under just the conditions of the plant cited, with poor draft, poor combustion and big losses. In the plant cited, after the change was made in the chimney, it was found that nearly 1 ton less of coal was burned on the night run, and at this rate it did not take long before the cost of the new stack was offset by the saving effected in fuel cost.

LYNCHBURG, VA. C. R. MCGAHEY.

KEEPING BELTS ON PULLEYS.

Sometimes belts are very perverse in their action, running to one side or the other of a pulley, seemingly without any reason whatever for so doing. But whenever such action takes place, on one pulley or on both, there is some very good reason for such action on the part of the belt. The writer saw a belt running nearly 2 in. off one side of a generator pulley, and the attendant had tried all manner of ways without avail for bringing the belt to track fair upon the generator pulley. The generator had been twisted around as far as it could go, nearly 2 in., and it had even been moved sideways. The driving pulley had been moved along on the shaft, but nothing seemed to cure the difficulty.

The attendant said that the belt had never run fair on that pulley, but since a new leather belt had been procurred the trouble was a great deal worse than before. Careful calipering did not reveal any difference in diameter between the edges of the pulley-face. The pulley seemed to be crowded a sufficient amount, and the attendant was at sea as to what was the matter with the pulley. After removing the pulley and replacing it in the opposite position from which it had been run upon the shaft, the belt just as promptly ran off one edge of the pulley, but it was on the other side from which it ran before. In other words, the belt always ran off the same side or edge of the pulley no matter which way that edge chanced to be faced. This proved beyond all doubt that the trouble was in the pulley and nowhere else.

That it was in the pulley was proved by removing the pulley again and placing it on a smooth, flat surface in such a position that the hub of the pulley was vertical.. Then, a common steel square, such as is used by the carpenter, was placed against the pulley, the blade of the square bearing on the true surface. Two chalk marks were made on the square, one at the edge of the pulley; the other mark was made as close to the center of the crown as could be determined. The pulley was 10-in. face, and when the marks were looked over it was found that the crown mark was nearly 1 in. from the center of the

pulley-face. The center of the belt always tries to run to the center of the crown, and that being out of center, caused the belt to run off that side or edge of the pulley which is closest to the crown-line. The proper remedy for a pulley defect of this character is to send it to a machine shop and have the crown brought to the center of the pulley-face. In this case it was not possible to spare the pulley long enough to permit a machine-shop operation, so some other method had to be followed, and it was decided to send for another pulley so as to have a duplicate at hand in case of breakage; then, when the new pulley arrived, the old one was to be turned off as found necessary. Meanwhile a scheme was devised whereby the belt could be brought back upon the center of the pulley and kept there.

The pulley was "lagged" until the crown was in the center of the face. The material required was some strips of cloth or thick paper. Some 10-oz. canvas was at hand, so that was used after being cut into narrow strips about 1 in. wide. Some common resin and a little machine oil were the other ingredients necessary. The resin was melted in a babbitt ladle. A litttle machine oil was squirted in and well stirred to mix thoroughly. Then a little of the mixture was removed upon a stick and allowed to cool. If it proved too soft or too hard more resin or more oil was added as was needed to bring the mixture to the most sticky condition imaginable.

After the resin and oil had been mixed to suit, it formed a sort of wax well known to all paper-mill workers as "lagging wax." It was kept warm when in use, so warm that the wax was soft like molasses. The belt was left on the pulley and a little wax was spread on one side of a strip of canvas. Then the strip was laid on the inside of the belt, waxed side up, and carefully wound around the pulley in such a position as to build up the diameter of the pulley in the middle of its face. Strips of canvas were wound on until the belt ran true with both edges of the pulley-face. It was found necessary to wind on only two strips of canvas in this case before the belt ran as true as could be desired. This lagging was allowed to run until it wore off, which required nearly nine months' daily running. Then the new pulley was put on and the old one trued up in a lathe, when that, too, ran all right.

Buffalo, N. Y. John Jackson.

THE BREAKING OF STEAM PIPES.

A steam-pipe accident recently came to the notice of the writer in which the pipe simply broke from its own weight while hanging suspended from overhead hangers. The pipe was 1 in. in diameter and there was about 20 ft. between supports. This distance was too great, it must be admitted, but even with lesser distances the strain upon pipes at the junction with fittings is not comprehended or even understood by many engine tenders. A 1-in. pipe 12 in. long weighs 1.67 lb. and its diameter at the bottom of the threads is about 1.25 in. The strain upon the metal at the point of contact between pipe and fitting may be roughly taken as $1.67 \times 6 + 1.25 = 8$ lb. Thus a pipe fixed at one end (unsupported at the other end) must carry a strain of 8 lb. at the roots of the thread.

When a piece of pipe is 10 ft. long and is suspended as above, the strain upon the metal is apparently 10 times that amount (8 lb.) for the single foot which is 10 ft. away from the fitting, but this is not true. The center of the tenth foot is 114 in. distant from the fitting, hence the 1.67 lb. of pipe has a leverage of 114 against 1.25, and its moment at the fitting would be $1.67 \times 114 \div 1.25 = 152.3$ lb. In like manner, the ninth foot, also the eighth and all the other feet, may be separately calculated and their several moments added together to obtain the total strain upon the pipe at the bottom of the threads close to the fitting.

The stress due to the first length of pipe was 8.016 lb., approximately. The sum of the stresses on the first and tenth feet is $152.3 + 8.016 = 160.316$, taking one-half this for an average load on each foot of pipe, from 1 to 10, which is found to be $160.316 \div 2 = 80.158$. Therefore, the 80 lb. is the average load or moment caused by the weight of each foot of pipe. To obtain the total load on the metal at the fitting, the average load must be multiplied by the length of the pipe in feet, 10, hence the total load which must be carried at the junction of pipe and fitting is $80.158 \times 10 = 801.58$ lb. stress upon the metal.

Taking the stress above calculated as 800 lb., in round numbers, the reason why the pipe breaks under that stress, which does not seem great to be carried by the metal, may be sought. But by a little thought it is found that the 800-lb. stress is not on each square inch of the metal. Instead, it is only upon whatever fibers of metal chance to be exactly 0.625 in. from the center of the pipe on the top side thereof. In other words, the 800 lb. represents extreme fiber stress to which the pipe metal may be subjected under the conditions noted above. Thus, once the average weight of 1 ft. of pipe has been computed and the fiber stress which may be caused by the given weight of pipe calculated, the stress caused by 1 ft. must be multiplied by the square of the length of the pipe (not by its length alone) in order to ascertain the total amount of strain caused at the junction of pipe and fitting by the unsupported weight of the length of pipe.

As the extreme fiber stress in steel should not exceed 12,000 lb. to 15,000 lb. to the square inch of cross-section, it is easily understood why this pipe broke under its own weight. It is obvious that the extreme fiber stress would be greater as the diameter of the pipe decreased, weight and length remaining the same. Therefore, were the outer fibers to break under the strain, the inner fibers would be subjected to a greater load and would break in their turn as soon as the outermost fibers failed and allowed the entire load to fall upon the inner fibers. Perhaps there is a section of pipe metal ½ in. x 1/16 in. which must carry the 800-lb. fiber stress. This amount is only 1/32 sq. in. of section, and, if loaded with 800-lb. stress, it would be equivalent to 25,600 lb. to the inch, extreme fiber stress. As the metal should only carry 12,000 lb. to 15,000 lb., as stated, it is not to be wondered at that the pipe broke under its own weight.

New York City. James Francis.

ELECTROLYSIS OF WATER PIPES AND RAILS.

Having had considerable trouble in a recent case of electrolysis of water piping, and finding very little to help me in the way of information on the subject in books or journals, I am sending an account of causes and cure and what information I could gather from engineers having had the same or similar troubles. It appears that the conditions in any two places may vary quite considerably as to voltage drop and current flow. A current of 5 amp flowing from ordinary piping to rails will materially weaken the piping in the course of one year, and a voltage drop of 6 volts is considered quite bad; all damage being done to the piece from which the current flows, due to the decomposition of earth salts at that point. In the case of one city in northern Pennsylvania the Council called for an investigation, which showed that, at various parts of the town, there was a current flow from the rails to the water pipes or from the pipes to the rails, varying from 0 to 30 amp. A bond was then made from piping to rail through an ammeter near the power house and readings here showed from 0 to 150 amp flowing, while at other points in the town which had previously shown current flowing, there was now no flow, indicating that the connection at the power house relieved the pipe lines, preventing further electrolysis. In the case of a city in North Carolina, tests showed a flow of current indicated by voltage drop of from 15 to 25 volts, which was corrected by careful bond testing and repairing. In addition, 500 circ. mil wire was laid from the busbars to points showing excessive leakage in the tests, which stopped all leakage.

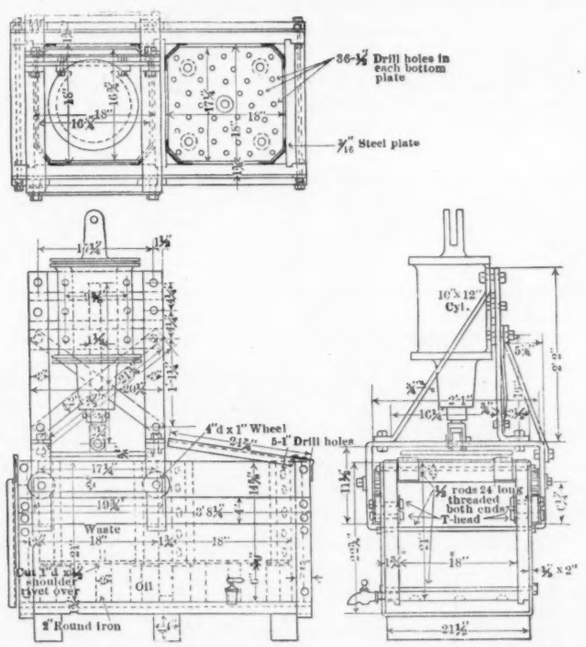
In another instance under personal attention, tests were made at various points in the town, showing current flows of from 0 to 60 amp in each direction, according to locality. Salts in earth at this place are very injurious, having eaten entirely through a No. 00 copper wire in the course of two years. Connection was made through 500 circ. mil wire from

water lines in power house to busbars and the tests on the outside were repeated showing practical elimination of the flow from pipes to rails. A careful rebonding of the rails eliminated all the trouble. An interesting phenomenon was the action due to the relative position of cars to test points. In some cases it made very little difference where the cars were, while in other places the intensity of the current increased as the cars approached, and in some cases reversed the direction after the car had passed. The writer would suggest as a remedy for all cases of electrolysis of piping, that generous connection be made from the pipes to busbars at power house as the quickest way of preventing troubles with water companies and consumers. This would doubtless prevent any electrolysis of the pipes but would not protect the rails, which must be kept carefully bonded, especially at all soft or marshy places.

BRADFORD, PA. H. E. HASTINGS.

TANK FOR RECLAIMING OIL AND WASTE.

In power-house operation the item of oil and waste, while not so large as some of the other items which appear in the expense sheet, is nevertheless heavy enough in large power houses to make the recovery of oil and waste desirable. The writer noticed in the shops of one of the large Eastern railway companies an oil press operated by air pressure and a waste tank which were utilized for this purpose. The accompanying illustration shows the details of the equipment. The tank into which the waste is thrown after being used is divided into two 18-in. x 18-in. sections, a 1¾-in. block extending nearly to the bottom. These sections are divided in turn horizontally by trays carried high enough to leave an oil chamber about 6 in. deep. The trays are made of steel plate ⅜ in. thick to withstand the pressure exerted from a 50-lb. air line and 36 ¼-in. holes in the bottom of the tray permit the oil to pass through.



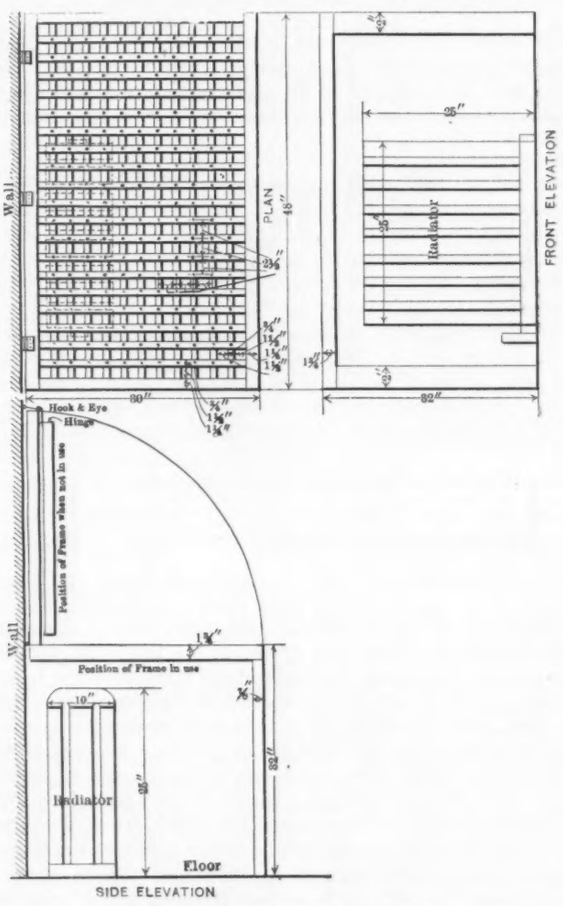
PNEUMATIC OIL PRESS FOR RECLAIMING WASTE AND OIL.

For utilizing the compressed air an old 10-in. x 12-in. cylinder and piston attached to a 17¼-in. x 17¼-in. x ⅝-in. plate bearing on the waste are provided. The braced framework on which this apparatus is carried is mounted on wheels so that it can be rolled from one chamber to the other by means of a track along the top of the tank. In operation it is customary to fill one compartment with oily waste and then allow the press to work while the other compartment is being filled. When the first lot has been squeezed dry, the press is shifted to the other chamber where it repeats the process. In the meantime, the waste in the first chamber is teased and the unglazed portions returned to stock after the dirt in them is shaken out. The reclaimed oil is drawn off from time to time through only one faucet, thus accounting for the space left between the base of the tank and the bottom of the division block. The tank is provided with two hinged tops, so that one chamber can be kept under cover while the other is under the press. The construction of the tank permits the easy removal of the trays whenever cleaning is necessary.

BROOKLYN, N. Y. PATRICK COLLINS.

BLUE-PRINT FRAME.

In blue-print work it is very desirable to have some means for drying the prints rapidly. In winter it is an easy matter to use the radiator for drying purposes; but the chances are that the blue-print frame will warp. In the pent house on the roof of the Milk Street headquarters of a Boston railway there is in use an interesting blue-print drying frame designed by a member of the engineering department of the company. This device was built to prevent warping when wet prints are laid upon it over a steam radiator on which the prints are dried when exigencies so dictate. The sketch herewith shows the make-up of the frame, which is made of white pine, halved and screwed at intersections, and is designed to fold up against the wall when not in use. The openings in the lattice work enable the heat to be applied efficiently to the damp or wet prints and the frame can be made easily and at trifling cost.



FRAME FOR DRYING BLUE-PRINTS.

BOSTON, MASS. H. DURING.

HIGHWAY SIGNAL SYSTEM FOR RAILWAYS.

The accompanying illustrations show the wiring diagram of signal circuits and other details of construction, including the design of a contact-making trolley hanger which serves to feed energy to the signals direct from the trolley wire, of an inter-

esting signaling system for the intersection of highways and railway lines. Six 10-cp lamps and a 10-in. gong are connected in series with a signal wire paralleling the trolley wire. The former is a single iron wire carried on the trolley poles for about 1300 ft. approaching a crossing. The signal system has

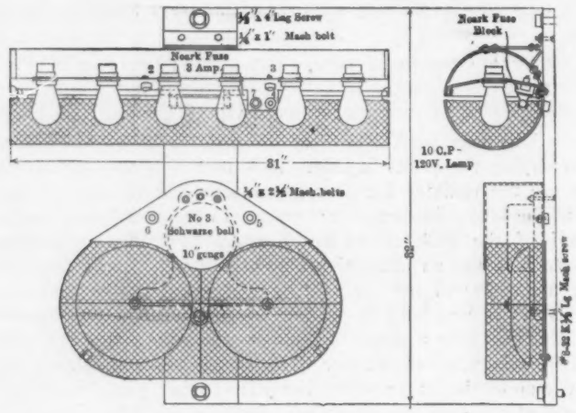


FIG. 1.—DETAILS OF LAMPS AND BELL.

been erected on double-track lines of the Twin City Rapid Transit Company and its operation is very simple, since contacts need be made only as the cars are approaching the intersection between the highway and the track. The contacts, which permit energy to pass from the trolley wire to the signal wire lighting the lamps and operating the bell while a car is approaching a crossing, are made in the form of signal trolley hangers. The hanger, as shown in the illustration, comprises an 18-in. stick of maple 1⅜ in. square in section. It is thoroughly boiled in paraffin, and trolley ears are fastened to the ends of this stick. The wood supporting the trolley ears is hung from the span wire by means of two bronze springs, which are assembled under tension and which, when the trolley wire is lifted by the passage of the trolley pole and wheel, permit of contact points fastened on the hanger stick to rise and make connection with brass contact plates connected with the trolley hangers. The contact points are connected to the signal wire, and the hangers are used to support the trolley at each span of the approach. Their springs are so adjusted that when a car is between two spans both adjacent hangers make contact and, therefore, there is no actual break in the circuit through the hangers to the signal wire from the time a car passes onto the first signal span until it passes the crossing. The process of making connections is simply a transfer of contacts from one signal hanger to the other with the arcing taking place only at the last hanger, that located nearest the signal bell. Such a simple arrangement for feeding energy to a crossing bell has an advantage over some other types of crossing signals in that no matter how many cars may approach the crossing the bell will continue ringing as long as there is one car under the trolley wire supported by the signal hangers. The lamps at the top of the signal post are enclosed, as shown in the engraving, in a sheet-steel hood bolted to the post. The lamps and gong are connected in series, so that not only the attention of a highway traveler may be attracted, but so the motorman on an approaching car may know that the gong is ringing if he sees the lamps burning.

Milwaukee, Wis. Herbert Cowing.

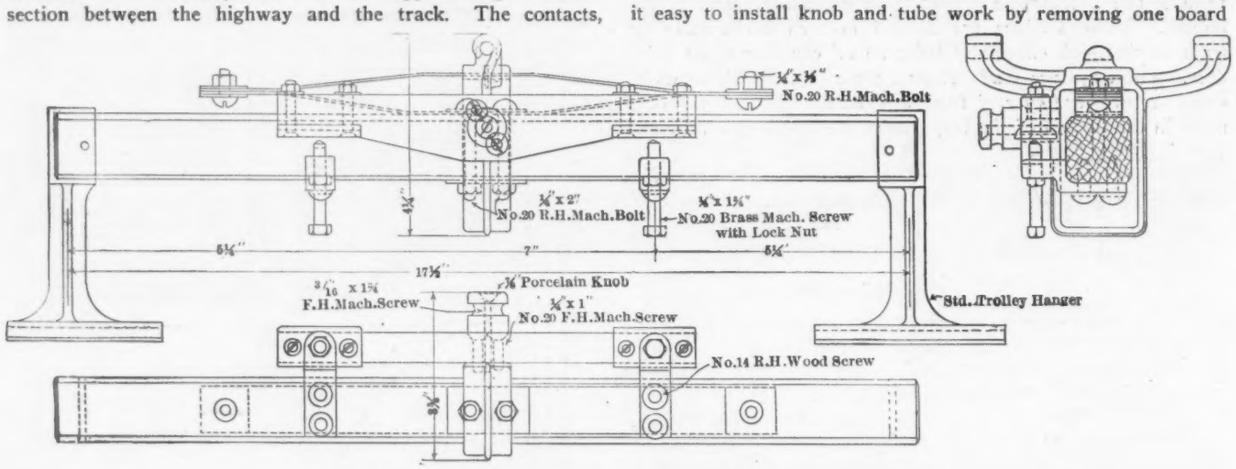


FIG. 2.—DETAILS OF TROLLEY-OPERATED CONTACT-MAKING HANGERS.

WIRING OLD RESIDENCES.

There have recently appeared in your columns some interesting articles on securing business in old residences. The writer recently took charge of a plant in a small city where the lighting company did not do any wiring. The contractors were charging exorbitant prices and simply demolishing a house to wire it; consequently the lighting business suffered. We made a 30-day offer to wire residences for the cost of material, doing the labor gratis, and assured the property owners that wiring could be installed without damaging decorations. The result was that we were overwhelmed with applicants and secured a great many new customers, connecting over 500 lamps, which to a small central station is a very nice additional load. By charging the ordinary retail price for material we came out about even on the labor, the customers were pleased and we obtained the business. In the ordinary frame residence, which is common to all small cities, pine floors prevail. This makes it easy to install knob and tube work by removing one board or by pocketing and fishing; but where wires are fished they must be protected by flexible conduit. Wall outlets and switch loops can be easily fished. In this way a job can be brought up to requirements and is quite cheap for an old house. A bit with a 4-ft. shank welded on will greatly facilitate the installation of this class of work.

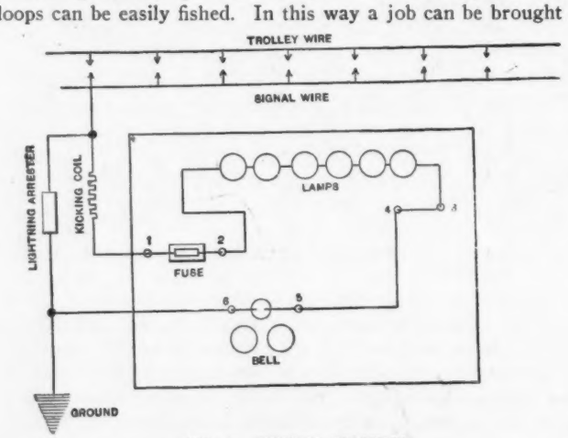


FIG. 3.—WIRING DIAGRAM.

Ozark, Ark. G. C. Abrams.

QUESTIONS AND ANSWERS

What would be the proper size of transformer for a load of 90 incandescent lamps of 32 cp? At the present time there is a 38-kw transformer with 1100-volt primary and a secondary winding, giving 6.6 amp feeding this circuit. D. S. B.

A 10-kw transformer will carry the load specified.

Will you kindly inform me what causes the singing noise in a motor or generator? My opinion is that it is due to the friction of the surrounding air and I would like to know if I am correct. H. A. S.

The friction of the surrounding air is responsible for some of the noise. Changes in magnetic conditions and vibration also add much to the hum. See answer to R. K. below.

Kindly advise me upon what principle overload circuit-breakers of high ampere capacity and without magnet coil operate? I suppose that the current carrying studs and laminated bridge in some way act as a coil. C. H. B.

In a circuit-breaker of 1000 amp and over, no coil is necessary as the main current in passing through the circuit-breaker passes around a magnetic circuit and one turn at 1000 amp gives 1000 amp-turns.

Why does a shunt-wound motor speed up when the field circuit is opened? A. T. I.

If the field circuit of a shunt-wound motor is opened while the armature is connected to the line, the armature will take an excessive current because it has a low value of magnetic field and cannot generate the necessary counter e.m.f. that limits the current under ordinary working conditions. Violent flashing and a burned commutator usually follow such procedure.

In hunting for troubles in direct-current motors, where should one begin in order not to waste too much time? L. C. C.

The weakest part of a direct-current motor is the commutator, and if this is watched, together with the brush holders, nearly all ordinary faults can be detected. Open circuits are shown by burning or arcing at the end of the commutator. Field circuit trouble is generally shown by a severe arcing on the brush holders, and the commutator has a burned or blackened appearance.

Kindly give me the answers to the following questions: What is the temperature of the glower of a Nernst lamp? What is the temperature of the filament of a tungsten lamp? What is the temperature of the filament of the carbon lamp? What is the temperature of the electric arc? What is the temperature of the mercury vapor arc? R. S.

The temperature of the Nernst glower is stated to be between 2200 deg. C. and 2450 deg. C. The temperature of the filament of the tungsten lamp is approximately 1850 deg. C. The carbon filament of the ordinary incandescent lamp has a temperature about 1660 deg. C. The arc between the two electrodes of the open arc lamp has a temperature of 3500 deg. C. The temperature of the mercury vapor lamp varies. In one case the figures given are as follows: Temperature at the anode, 148 deg. C.; temperature at the cathode, 164 deg. C., and the temperature midway between the cathode and anode is stated to be 164 deg. C. The data given are, of course, only approximate and for ordinary conditions of operation.

Will a set of wet cells operate a gas engine ignition system as satisfactorily as dry cells? I have eight ordinary carbon-zinc wet cells connected to a gas engine coil which is marked 6 volts. The engine will not run on these cells, although I have known other engines to run on such batteries. The engine runs satisfactorily on four dry cells, which give a much better spark. How can I get the wet cells to operate? A. E. H.

Generally speaking wet cells are better and more reliable than dry cells. The lower cost and portability of the dry cell, however, render it better for certain classes of service than the wet cell. The probabilities are that the porous cups or carbons in the wet cells are worthless. Immerse the cups or carbons in boiling water for about one-half hour and then let them dry well. If after this treatment the battery does not work when the carbon is inserted in the sal-ammoniac solution, the probabilities are that new carbons are required, provided that fresh sal-ammoniac solution and good amalgamated zincs are used. There is a feeling among users of wet batteries that the solution and the zincs only require replenishing and that the carbons last indefinitely and require no attention. Such is not the case.

Will you kindly suggest a remedy for a 110-volt, bipolar, shunt-wound dynamo which fails to build up? I have tried reversing the field terminals and every other connection I can think of. The machine has not been run for over a year, but I do not imagine that there is any serious trouble with it, for it will generate readily when its field coils are excited with energy from another machine. C. A. F.

The usual causes for such action on the part of a generator are as follows: Residual magnetism too weak or destroyed; reversed connections or reversed direction of rotation; short circuit in the machine or in the external circuit; field coils opposed to each other; open circuit; brushes not in proper position. A short circuit in the external circuit will keep a shunt-wound dynamo from building up its field magnetism until the external circuit is opened. Slight short circuits within the machine may bring about the result mentioned. Two many lamps or other load might also cause the defect, in which case the load should be disconnected in starting. The fact that the dynamo operates satisfactorily when its coils are energized from an external circuit indicates that the connections are not reversed and that the magnetism is too weak. Place a voltmeter first across the external source and then across the armature, taking the corresponding readings; the latter reading should exceed the former. If this is not the case, test for all the causes mentioned.

Is it advisable to bank a 5-kw, single-phase transformer with a 10-kw transformer or a 2-kw transformer on a 2300-volt primary circuit with 110-volt secondary circuit or should only transformers of the same size be operated in parallel? H., L. & P. Co.

Transformers of different sizes may or may not operate satisfactorily in parallel. The prime requisite is that the total series impedance of one shall be to the total series impedance of the other inversely as the rating of one is to the rating of the other. In this case the currents of the two transformers will be in correct proportion. However, even in this event, unless the ratio of the resistance of one transformer to the reactance of that transformer is the same as the equivalent ratio in the other transformer, the arithmetical sum of the currents in the two transformers will be slightly greater than the total load current. We have published some excellent articles on this subject in the weekly editions, two articles appearing in the issue dated Nov. 21, 1908.

In an article, "Magnetic Variations and Dead Points in Motors," there appears an expression, $\frac{1}{n(n+1)} \times$ pole pitch. I would appreciate any information as to what can be judged from the result of this expression. R. K.

If the slot pitch of the rotor of an induction motor was such that there were $n+1$ teeth and slots under a field pole at any instant, and if there were n stator teeth and slots per pole, the proper conditions would exist to give minimum change in magnetic reluctance with different rotor positions, provided n represents an integer. If the quotients of pole pitch divided by slot pitch of stator and rotor bear any other ratio than that shown, the magnetic variations will increase and consequently the magnetic vibrations and noise will increase. This may be shown by an example: Suppose the pole pitch is 10 in., primary slot pitch 1 in., and secondary slot pitch 0.9 in. Then the distance the rotor will move in passing from a position of initial reluctance to the next successive position of equal reluctance is $\frac{1}{10 \times 11} \times 10 = 1/11$ in. If the secondary slot pitch is slightly smaller, say, 0.825 in., the number of teeth and slots under a pole will be 12 and the distance between positions of equal reluctance will be $\left(\frac{1}{10} - \frac{1}{12}\right) \times 10 = 1/6$ in., or nearly twice the distance obtained with the first assumptions. An inspection of the equation also shows that as the value of n is increased the variations in reluctance will decrease. There is, therefore, a tendency for a machine which has a comparatively small number of teeth per pole to make more noise than one having a larger number.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Some Experiments on Electric Cooking.

In a Chicago family, where there is a complete set of electric cooking apparatus, some experiments have been made to determine the monthly consumption of electrical energy where all of the cooking was not done electrically, but where a combination of two methods was used. These experiments were made by a central-station man to determine the probable monthly energy consumption if electric cooking were introduced as an auxiliary to other methods, as it would be in the large majority of cases.

In one of these tests an attempt was made to imitate conditions as they would be in a family where a coal range is used for heavy baking. All light ordinary cooking not needing an oven was done by electricity. There were four to five persons in the household. This resulted as follows:

Total kw-hours for 30 days	77.2
Person meals	398
Kw-hours per person meal	0.194
Maximum demand	19 amp.

Previous tests in the same family showed that from 105 to 120 kw-hours would ordinarily be used per month to do all the cooking electrically, hot water being supplied by other methods. This test indicates what a large proportion of the total energy used for exclusive electric cooking goes into the oven, and indicates the desirability of effecting more efficient methods of baking, utilizing the fireless cooker principle of heat insulation.

Another experiment, lasting 38 days, was made to determine the amount of current used by the electric iron, chafing dish and coffee percolator in the same family. In this family it has been the custom ever since electric cooking apparatus was installed to make considerable use of the chafing dish, as it is found to be one of the most convenient electric cooking utensils. Besides the regular chafing dish uses (as it was of the Simplex type), the chafing dish could be removed and the plain stove top was frequently used for making toast. The consumption of the iron, chafing dish and coffee percolator was found to be at the rate of 20 kw-hours per month. This figure is of considerable interest because it indicates what can be done in many houses without a special cooking circuit.

Influence of Rates on Central-Station Residence Business.

Before a recent meeting of the British Institution of Electrical Engineers, Mr. W. R. Cooper presented a paper entitled "Domestic Electricity Supply (Including Heating and Cooking) as Affected by Tariffs," in which he discussed present systems of central-station rates and suggested a system differing from any of these. The paper opens with the following statements:

I.—Almost all existing tariffs have discouraged the use of electric energy for domestic power purposes because they were devised primarily for consumers requiring light. The maximum-demand system, though excellent in theory, is now harmful; and the combination of a flat rate therewith is not satisfactory because it involves duplicate wiring.

II.—The load on any station must consist of a lighting load superimposed on a power load, and no tariff will eliminate the peak due to the former. But by encouraging the domestic power load through suitable tariffs the lighting peak may become much less important relatively.

III.—For the purpose of devising tariffs the load may be divided into the power load (including some lighting), which is more or less uniform for a great part of the day, and the lighting load, consisting of the familiar peak. The charges peculiar to this peak load must be met by a yearly payment, or special rate, the rate per unit being otherwise small. Consideration of tariffs based on ratable values, on two-rate meters and on the "wattage" of lamps installed, favor the latter.

IV.—Taking into account the special circumstances of domestic supply it is estimated that the flat-rate part of the tariff might be fixed profitably at ¾d. to 1d. per unit for consumers taking energy for lighting.

V.—Although the prospect of heating houses entirely by electrical energy is remote, electric heating must be regarded as a very promising auxiliary to other methods. Electric cooking is handicapped by the cost of heating water electrically. Its special advantages should, however, ensure its extended use as an auxiliary method.

The subject is then discussed under the heads of existing tariffs; essentials of a satisfactory tariff; possible tariffs; limits for the flat-rate part of the tariff; the economic aspect of heating and cooking. The conclusions of the paper are as follows:

1. The use of any tariff involving a maximum demand, or duplicate wiring, is inherently adverse to the use of electric power for domestic purposes.

2. A simple flat rate is inadmissible.

3. The tariff should require payment of a fixed sum per annum, based on the total "wattage" of the lamps installed plus a low payment per unit used.

4. The latter payment should not exceed 1d. per unit, and may frequently be, say ¾d., owing to the special circumstances of the case.

5. Such a tariff would greatly encourage electric heating as an auxiliary to other methods.

6. Although electric cooking cannot be expected to displace cooking by coal, it should take an important position, equal or superior to that of gas cooking at the present time, if the price per unit does not exceed 1d.

7. The load factor of stations supplying only a lighting load would be materially improved.

8. The load so obtainable is highly important to stations at present dependent almost exclusively on lighting, and should receive very careful attention at the present time as affording an antidote to any diminution of the output due to the use of metallic-filament lamps, and to possible legislation as to the greater utilization of daylight.

Central-Station Notes from Fairbury, Neb.

The Fairbury Light & Water Company, of Fairbury, Neb., has a combined waterworks and electric light plant which is a good example of a well-managed undertaking of this kind which has paid steady dividends for a number of years past, the regular dividend rate being 8 per cent.

The electric generating capacity of the plant is 260 kw in three units. The smallest of these is a 35-kw, 1100-volt, single-phase, 60-cycle Wood alternator, belted to a condensing Corliss engine. This is operated to carry the all-day load. Another simple condensing Corliss engine drives a 75-kw Westinghouse revolving-field alternator, and a tandem-compound condensing engine drives a 150-kw Wood alternator. Condensing water is obtained from a river near by. The water supply for the waterworks is obtained from wells near the plant and from a spring some distance away, which is piped to the plant. All of the pumping is done by steam.

The boiler equipment consists of one upright boiler, made by Vincent Kenney, of Omaha, of 250-hp capacity and two horizontal return flue boilers, rated at 75 hp each. The coal used is Kansas lump, costing $4 a ton. The high price of coal accounts for the use of condensers throughout in such a small plant, which is unusual where coal is cheap.

Some consideration is being given to the installation of an

electric pump to pump water during light-load periods, as the steam pumps are not very economical in their present condition, and it is thought that coal might be saved by carrying both water pumping and electric power loads from a single condensing Corliss engine through the medium of an electric motor.

The station is located in a good brick building which is now becoming somewhat crowded. One condenser pump takes care of all the Corliss engines and waterworks pumps. The regular routine is to operate the large upright boiler most of the time. On Sunday nights the smaller boilers may be started. The belts of the plant are in remarkably fine shape, and have a record rarely equaled. One 20-in. double leather belt has been in operation 15 years, and at the present time looks almost like new. "Cling surface" has been used on these belts.

The plant is operated in eight-hour shifts, one man to a shift. There is also a chief engineer, who does not take a shift. The employees of the plant consist of one manager, three firemen to operate the three shifts, one chief engineer and three wiremen. The company does wiring of buildings. The total number of employees is therefore eight.

The company has made a remarkable record in the rapid introduction of single-phase motor service. Day service was begun in May, 1908. By October 74 hp in motors, ranging in capacity from 3 hp to 15 hp, had been connected. The motor business by October was bringing in gross revenue of $150 per month. The day load was in the neighborhood of 37 amp at 1100 volts, single-phase.

The rates for residences are 17 cents per kw-hour, with $1 minimum bill. The commercial rates are somewhat mixed. The company operates 35 street arc lamps, 6.6-amp, series alternating current, for which it receives $93.60 per lamp per year. The peak load in December, 1907, was 150 amp at 1100 volts. By September, 1908, the peak had reached an equal figure. Many tungsten lamps are to be seen around the business district, but there is the general short-sighted inclination of consumers to use these lamps bare without proper diffusing and reflecting equipment.

The annual electric earnings of the plant are about 23 per cent, and the water earnings about 13 per cent of the total permanent investment, making the total gross annual earnings about 36 per cent of the investment. About 60 electric irons have been introduced. The company is under the management of Mr. R. D. Russell, vice-president.

Introducing Household Electrical Appliances.

BY J. O. LITTLE.

In introducing household electrical appliances, naturally the line of argument is quite different from that which may be found quite effective with respect to industrial application of electricity. The manufacturer who considers electric drive in comparison with mechanical drive reasons from an entirely different viewpoint than the housekeeper who is considering a washing-machine or sewing-machine motor. He has always had to pay for power; she has never had any power bills, only bills for labor, and she is slow about making a direct comparison. He is seeking economy of production and figures on that basis. He learns that the motor means greater convenience, greater cleanliness, economy of floor space, less waste of finished product, greater flexibility, increase in output, etc. He reduces all these to one item, the cost of power per unit of output, and draws his comparison.

The housekeeper, on the other hand, if she has always done her own washing and ironing and sewing, fails to give due consideration to the value of her own time; if she has always hired the work done, she concludes that she couldn't get along without hired help anyhow and that these articles would mean an unnecessary expense. Take the case of the woman who has always done her own work. She has two distinct aims: one to accomplish her household duties regularly, the other to have some time left in which to take recreation, either in pleasure in the common acceptance of the term, or in church or charitable work, with which pleasure is intermingled. She may take pleasure in her regular household duties, but it is only the pleasure that comes from doing one's duty. She draws a distinct line between this and the pleasure that she looks forward to as something to afford her a change of atmosphere. However frugal she may be, she always saves a little pin money to spend for pleasure. She may spend this in various ways, but a certain portion usually goes for downright pleasure. She works hard and what she needs and is entitled to is relaxation of mind and body. If the work were less hard she would need less relaxation. If she could stay at home and rest all morning, she wouldn't care much whether she went to the bargain matinée or not.

Now, right here is where the electrical appliances come in, and specific arguments to that effect are not difficult to formulate. She can lighten her work by their use, and a very little of the money that would otherwise go for relaxation will foot the bill for current. Less than the price of a glass of soda water will save her all the fatigue of a day's sewing; the price of the cheapest seat at a bargain matinée or the difference in price between the best and next best seat at a regular performance will more than buy enough current to do the entire washing and ironing.

It is a question for the housekeeper to decide whether it is better to lighten the domestic load and have a little less money to spend on less needed recreation, or to let the load remain as it is and need much more and get a little more, recreation. When she comes to look into the question more carefully, it seems that there can be but one possible answer, viz., that it is better to lighten the burden; better to prevent excessive fatigue than to try to counteract it. If it means a little less money for recreation, it will mean more time, greater strength and better spirit for it. The cost of doing the more burdensome household duties, adding the items of interest and depreciation to the cost of current, is too small for serious consideration by any but the housekeeper who counts the nickels and dimes most carefully, and she is the one who needs their assistance most.

It is a question if a house that is thoroughly equipped with electrical appliances is not better off than a similar house with a servant. Electricity takes care of washing, ironing, sewing and sweeping, in splendid fashion, and leaves the operator little to do except to look on and engineer the work. The cost of the necessary apparatus and current to operate it is but small when compared with a servant's wages and board.

As for the combination, electricity and hired help, there are two things especially that should not be denied the servant—the electric washer and wringer, and the sweeper or vacuum cleaner. Washing is a hard task and if there is only one domestic, it generally has to be done out of the house; if at home, all the other duties of the day fall upon the housekeeper. But if the electric washer is used, the labor is lessened and the time required for the operation is shortened. The servant can have a large washing done by the middle of the forenoon and be fresh for her other duties. The few cents that the energy costs is a small price to pay for the freedom that it gives the housekeeper on washday, to say nothing of the feeling of contentment with her work that it inspires in the servant.

Vacuum cleaning is sanitary and sweeping is not; no further argument is needed, servant or no servant, especially in a household where there are small children. If it lessens the labor of the servant, she will be better contented and more willing to remain.

The electric iron permits faster and better work and it is a question for the housekeeper to decide if it isn't worth a few cents more to save the servant's time for other duties.

Some housekeepers argue that a servant will consume just so much time anyhow and that the iron is too expensive a thing to give her. They fail to consider that the cost per week of owning the iron is almost negligible and that a good servant will appreciate its benefits and use the time it saves her, for other duties. They should bear in mind, too, that its benefits

are not confined to the laundry, for the different members of the family will find plenty of use for it in other parts of the house; mother and daughter for pressing and ironing laces and other articles not to be entrusted to domestics; father and son for pressing trousers and neckties in emergency cases.

When it comes to the sewing-machine motor it is not a question of the servant, but of the sewing girl who comes to sew by the day or week. Looking at it in the worst way, she will manage (if she works by the day) to accomplish no more than she would have accomplished if you hadn't had the motor. The experience adds just about five cents a day to her wages. But if she is honest and works right ahead, she will accomplish much more (twice as much on plain work) than is possible with a foot power machine, and thus save her employer many times five cents. Manifestly it is better to get a girl who does not loiter and give her the motor-driven machine.

By keeping in mind the special economic situation with respect to the household, many other lines of argument similar to the above can be brought to bear in a campaign for increasing the central-station income from residence business.

A Notable Flat Rate Business at Wichita, Kan.

The Edison Light & Power Company, of Wichita, Kan., operates what is probably the most remarkable flat-rate circuit in the country. On this circuit are included the special street lamps in the downtown district, and the flat-rate sign, window and outline lighting. A separate three-phase circuit is run from the power house a distance of about three blocks to the center of downtown distribution. This circuit is turned on every day as soon as window lighting is necessary and turned off at midnight.

Seven blocks on Douglas Avenue and six blocks on Main Street, the principal business streets, constitute the "Great White Way" of Wichita. Although the city has only 45,000 population, the density of special street lighting on these 13 blocks is probably not equaled in any other city in the country. There is one 6.5-amp, alternating-current, 110-volt multiple arc lamp for every 25 front feet, thus making eight of these arcs for every 100 lin. ft., or an expenditure of 3680 watts per 100 ft.

These lamps are suspended on catenary construction, the

FIG. 1.—NIGHT SCENE ON A WICHITA STREET.

FIG. 2.—WICHITA STREET SHOWING SPECIAL LIGHTING.

catenary cables being hung from pole to pole along each side of the street. The lamps, of which there are 405 in all, are suspended at a uniform height of 10 ft. 6 in. They are equipped with opalescent globes and steel shades which confine most of the light to the street and sidewalk and do not interfere with outlining, signs or window lighting.

The installation was made at the expense of the central-station company. The merchants, block by block, entered into contracts with the company (originally for one year, and since renewed for a second year), all the merchants in a block signing an agreement to pay $4 per month for each lamp. Each merchant pays for the lamps in front of his property. The average time of burning is 5.5 hours per night. Figs. 1 and 2 show the appearance of the streets.

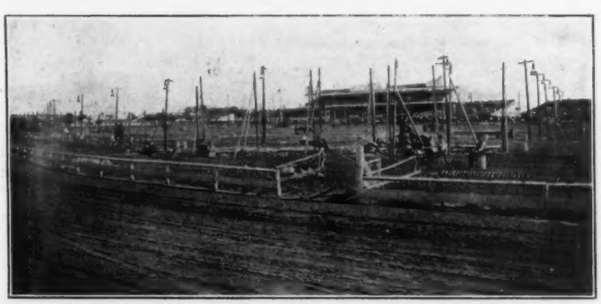
Besides the 186-kw load afforded by this special street lighting, this flat-rate circuit has enough sign, window and outline business to give it a load of 310 kw. The window and outline lighting is figured on a rate to yield the company a gross revenue of about 7 cents per kw-hour. This feeder has a separate panel and is provided with a recording watt-hour meter. It is found in practice that the gross revenue from this flat-rate feeder yields 5 cents per kw-hour in summer and 6.5 cents per kw-hour in winter, as measured at the station busbars. The flat-rate business, as stated before, is carried by a three-phase feeder run from the power house, which supplies 25-kw transformers in the business district.

INTERIOR WIRING AND ILLUMINATION

Illumination of Wild West Show.

What is said to be the largest outdoor area ever artificially illuminated with any approach to the ordinary intensity of indoor illumination was the field at the Minnesota State Fair, Minneapolis, Minn., a few weeks ago, on which was given the spectacular reproducion of "Fort Ridgeley in '62." In this event more than 800 people, including 350 Indians, took part.

The field on which this reproduction was held comprised about 360,000 sq. ft. of land, the plot being 900 ft. x 400 ft. in area. It was illuminated by 26 Excello flaming-arc lamps distributed approximately 100 ft. apart around the outer edge of the field. Each lamp was equipped with a reflector and with



FLAMING ARC LAMPS AT MINNESOTA STATE FAIR.

the exception of the lamps located on the side farthest from the grandstand, the reflectors were arranged to direct the light toward the center of the arena. The lamps located at the far side of the field were arranged to illuminate the scenery which supplied the background for the staging of the spectacle. The reflectors used were of the ordinary sheet-steel type, the inner surface of which was painted with white enamel paint. The energy for lighting the amphitheater was obtained from the lighting circuits of the city.

As is shown by the accompanying illustration, the spectators' seats were arranged along one side of the field on which the play was staged. The lamps were suspended on poles located at the outer edge of the arena in such a way that they completely encircled the field. The feed wires were so placed that none was carried across the field. By this arrangement the view of the spectators was unobstructed and a clear field was had for developing the illumination, which afforded an even, well-balanced effect in all parts of the field. Intensity of illumination at various points during the progress of the event was found to be so high and well distributed that the details of the reproduction could be plainly seen from every point of vantage. The power consumption of the installation was found to be about 0.04 watt per square foot of surface lighted.

The officials of the fair states that they were exceedingly well pleased with the results accomplished by the system of illumination used and assert that the conditions under which the spectacle was enacted more nearly approached daylight than was ever before found possible in the reproduction of spectacle of similar magnitude.

The Illumination Design of a Clothing Store.

BY J. R. CRAVATH.

Some of the problems dealt with in designing the illumination of the large clothing store of Block Brothers Clothing Company, St. Joseph, Mo., recently completed, may interest others engaged in illumination work. This store, which occupies a new building erected especially for the use of this concern, comprises three floors, of a total area of about 33,500 sq. ft., not including the basement, which was also wired with a view to its ultimate use for merchandising purposes.

A typical floor plan is shown in Fig. 1, which is a plan of the third floor. The building has reinforced concrete floors. This feature, of course, necessitated the location of all the outlets and the letting of the contract for wiring before any of the floor construction was begun. The floors consist of a reinforced concrete slab on which cinder concrete is placed as a filler between the slab and the hard maple floor. Conduit was laid on the reinforced concrete before the cinder concrete was poured. An extra deep Krantz steel outlet box was used so that the conduit could be run straight into the box, an arrangement much preferable to using a shallow box with troublesome short bends to reach it.

At the outset three possible systems of lighting naturally presented themselves for consideration; namely, by arc lamps, incandescent lamps and Nernst lamps.

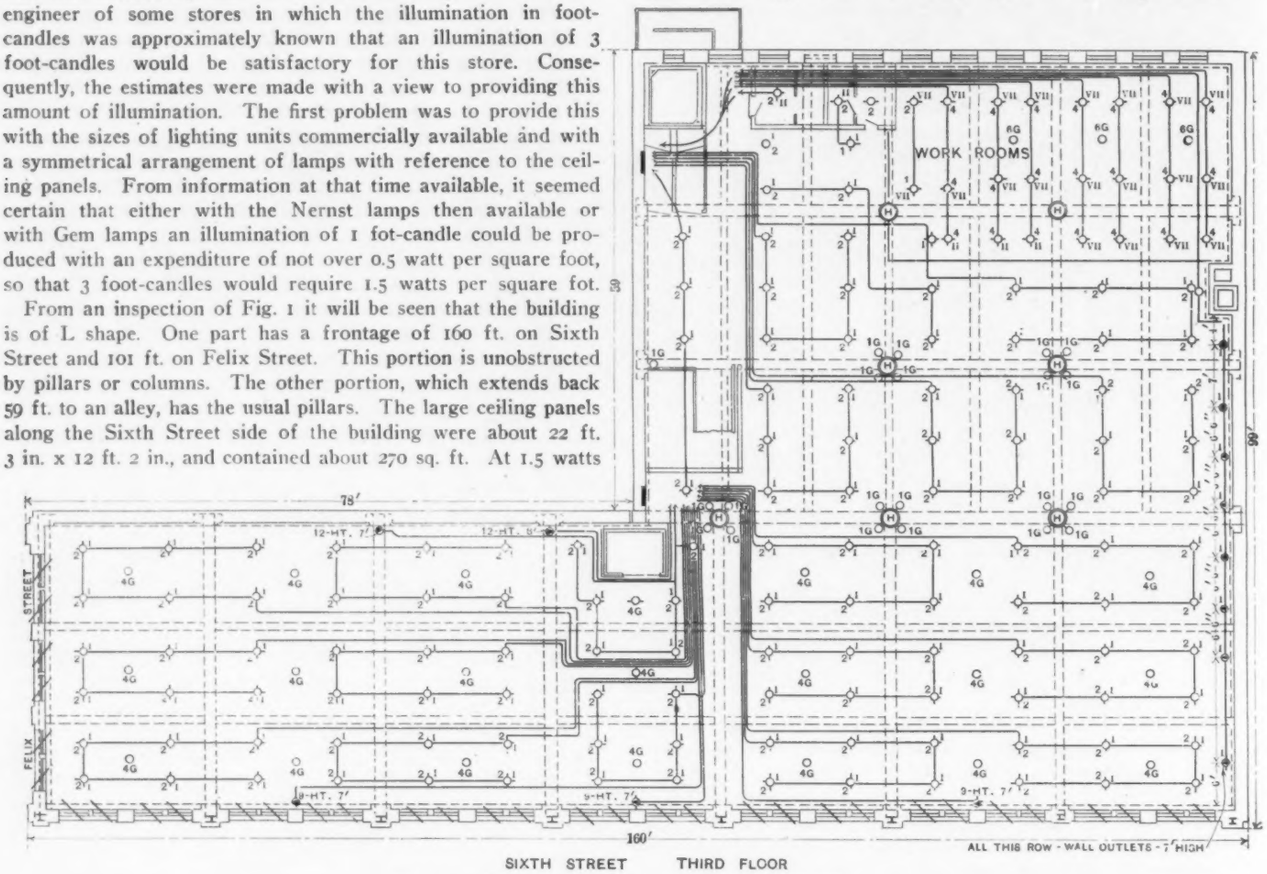
The only system of lighting a high-class store of this kind by arc lamps which seemed at all suitable was that employing special ceiling construction and light-balancing selective diffusers over each arc lamp. As the architect's plans for the building had been practically completed before the writer's work began in planning the illumination, this system could not be considered. Arc lamps without light-balancing ceilings were not thought suitable because of the unsteadiness of the light. Added to these considerations was the fact that higher efficiency incandescent lamps were at that time a practical certainty, and it seemed likely that the common arc would be soon outclassed in efficiency.

This left as the two possible systems to be considered Nernst lamps and incandescent lamps. At that time (August, 1907) the tungsten lamp was still in the future as a commercial factor, although its perfection seemed certain at that time. It, therefore, seemed wise to make plans in such a way as to provide for the use of tungsten lamps when they should become commercially available. Inasmuch as it seemed then as if considerable time might elapse (possibly 18 months or two years) before the tungsten lamp would be available, it also seemed wise to provide for the use of either the Nernst or Gem incandescent lamps at first. The outlets were accordingly arranged with a view of using tungsten, Gem or Nernst lamps. For several reasons it was considered better to arrange for several medium-sized units in each bay or section, rather than to depend on a cluster in the middle of each section. The principal

object of thus subdividing the light sources was to reduce shadows and produce uniform illumination.

It was decided by the owners after an inspection with the engineer of some stores in which the illumination in foot-candles was approximately known that an illumination of 3 foot-candles would be satisfactory for this store. Consequently, the estimates were made with a view to providing this amount of illumination. The first problem was to provide this with the sizes of lighting units commercially available and with a symmetrical arrangement of lamps with reference to the ceiling panels. From information at that time available, it seemed certain that either with the Nernst lamps then available or with Gem lamps an illumination of 1 fot-candle could be produced with an expenditure of not over 0.5 watt per square foot, so that 3 foot-candles would require 1.5 watts per square fot.

From an inspection of Fig. 1 it will be seen that the building is of L shape. One part has a frontage of 160 ft. on Sixth Street and 101 ft. on Felix Street. This portion is unobstructed by pillars or columns. The other portion, which extends back 59 ft. to an alley, has the usual pillars. The large ceiling panels along the Sixth Street side of the building were about 22 ft. 3 in. x 12 ft. 2 in., and contained about 270 sq. ft. At 1.5 watts per square foot these panels would, therefore, require 405 watts. It was decided to wire these panels for four 110-watt units, thus permitting the use of the 110-watt single-glower Nernst lamp, which had just been brought out at that time, or have the group operated symmetrically from any one circuit. This latter provision was, of course, for the purpose of producing a symmetrical appearance when only a part of the lamps in the store were operated, and also to make it possible to light a certain section effectively without lighting other sections where artificial illumination might not be needed at the time. At a number of points flush floor outlets for showcase lighting were provided, these outlets being located as far as possible in



SIXTH STREET THIRD FLOOR

FIG. 1.—TYPICAL FLOOR PLAN, SHOWING OUTLETS.

FIGS. 2 AND 3.—ARRANGEMENT OF LAMPS FOR LIGHTING STORE.

the tungsten lamps later. The panels on the alley side of the building being approximately 11 ft. 1 in. x 19 ft. 10 in., with an area of about 220 sq. ft., called for 330 watts at 1.5 watts per square foot. It was decided to provide for three 110-watt units in each of these small panels.

The next problem was to group these units in such a way as to get the greatest possible use of each 660-watt circuit and also places designated by the store-fixture architect. Provision was also made for possible boulevard lamps along the curbline and for an electric sign on the marquise over the Sixth Street entrance. The total connected load in the building, using the maximum 110 watts at each outlet for general lighting and the maximum capacity of show-case outlets, was estimated at about 96 kw. The cost of wiring, not including fixtures or any work

beyond the outlets, was $45.80 per kilowatt and $6.50 per outlet.

Some unusual precautions were necessary in planning the circuits supplying the various lamps because of the possibility that Nernst lamps would be used at some outlets for general store lighting, while incandescent lamps would be necessary at other outlets. As the Nernst lamps then offered were of the 220-volt type, and as it did not seem desirable to have 220-volt incandescent lamps, the circuits upon which incandescent lamps might be used had to be kept independent of those upon which Nernst lamps might be used. Provision was also made in the cut-out cabinets for the change of any circuit from 110 to 220 volts, or vice versa.

It was the desire of the owners to provide gas for breakdown use. This was done by arranging for a four-burner chandelier of inverted gas-mantle burners in the center of each large panel and brackets carrying inverted-mantle burners around each pillar. Mantle burners were provided for because of the use of natural gas and because of the larger amount of light to be obtained per burner, although in general the use of gas mantles for breakdown service is not to be recommended.

So much time elapsed between the making of the wiring plans and the completion of the building that the lamp situation underwent a considerable change. The tungsten lamp had been in commercial use several months before it was necessary to make the final decision as to the kind of lamp to be employed. The recent Westinghouse Nernst lamps of higher efficiency than the old types had not appeared on the market and the conditions seemed to point without question to the use of the tungsten lamp. While it seemed certain that the maintenance cost of these lamps would be high at the outset, it also seemed certain that this maintenance cost would be considerably reduced soon by the reduction in cost of lamps and an improvement in their durability.

The arrangement finally adopted for the general lighting of the store (see Figs. 2 and 3) was to place in each outlet a 60-watt frosted-tip tungsten lamp. It is well established that the height of lamps above the floor in a large store of this kind, where many units are used, makes little difference in the illuminating results if proper reflectors were used, as each lamp helps its neighbors more the higher the lamps were placed above the floor, thus counteracting the decreased illumination received from any one lamp at a point directly below that lamp. It is desirable to place the lamps high so as not to interfere with vision. The fixtures are 2 ft. 6 in. over all on the second and third floors of the building, where the ceiling height is about 16 ft. and 3 ft. over all on the first floor, where the height is about 18 ft. This length of fixture brings the lamps low enough from the ceiling so that the ceiling appears more evenly illuminated than if the lamps were placed close to the ceiling. At the same time, the fixture is short enough so that the store does not look like a fixture display room—an effect to be feared where there is so large a number of fixtures as were necessary here. The form of fixture adopted finally was a combination of square rod and chain, as seen in Figs. 2 and 3.

The reflectors used were naturally a matter of much consideration because of the necessity of combining good efficiency with neat appearance. It was hoped at one time that it might be possible to secure a prismatic reflector ball of high enough efficiency so that the use of an open reflector would not be necessary, as it was thought that a ball would present a much neater appearance. It appeared, however, after tests that a reflecting ball in which the upper half is a prismatic reflector and the lower half frosted glass is inherently inefficient, the loss being so great that it could not be considered for this work. With the elimination of this possibility, the only suitable glassware to use appeared to be an open reflector of the deep-bowl type. Of these general types two kinds were available, the opal bowl and the prismatic bowl. As regards illuminating performance and diffusion or softening of the light in a large interior of this kind, these two types seemed to be nearly on a par. The total absorption of the opal bowl is slightly greater, and the amount of light thrown upward toward the ceiling is greater. It is considerably cheaper than the prismatic bowl and easier to clean. With these facts before them, the owners chose the prismatic type on the ground of appearance. The reflector used in the general lighting is Holophane 6061.

With 60-watt lamps at each outlet the current density now is 0.82 watt per square foot. While no measurements have been made upon the illumination, it is judged to be in the neighborhood of 4 foot-candles, this judgment being based upon casual inspection and upon figures obtained in similar rooms where the illumination has been measured. Conditions with the store and lamps clean and new are, of course, favorable to high results. The ceilings are nearly white and the walls a light olive green. The woodwork is dark, of a greenish tinge, and the floors of maple. The results are very satisfactory to the owners and the illumination is considered by them and the general public at St. Joseph one of the several notable features of this new store.

In drawing up the specifications for the fixture and lamp equipment, the plan was employed of giving each outlet a Roman numeral which would not become confused with any of the other standard symbols used. Referring to Fig. 1, outlets marked by *I* are the regular standard one-light pendants used for general store lighting, each carrying a 60-watt frosted-tip tungsten lamp with reflector and Form H holder. Outlets marked *II* are provided with an outlet box receptacle, this receptacle being provided with a ceiling lamp and pendant switch by having a Benjamin series current tap screwed into the receptacle and the cord for a pendant switch led out through the current-tap bushing. This current tap has a standard metal shell which will take the regular shade holders.

The general plan for outlets not in the main portion of the store, where the requirements were uncertain at the time the specifications were drawn, was to specify an outlet box receptacle. This receptacle would permit the use of an extension plug with a dropcord or the use of a current tap with lamp, reflector and pendant switch, as before mentioned. In the workrooms, the specifications called for more outlets than in the store because the requirements would be more exacting.

Outlets marked *IV*, in the show windows, were equipped with "poke-bonnet" reflectors, each taking a pair of 50-watt tantalum lamps. The conditions of the beamed ceiling and the wishes of the owners would not permit the use of anything but a trough type of reflector. The windows are 5 ft. deep and vary in height from 12 ft. to 7 ft. In the higher windows a more concentrating reflector than the "poke-bonnet" would have been desirable.

There are in all 379 tungsten lamps in use for general lighting purposes in the store and workrooms. In the windows 144 tantalum lamps are required. There is also a large sign on Sixth Street and another on Felix Street, each sign containing about 100 4-cp sign lamps. There are a few carbon-filament lamps used in the basement, storage rooms and passages. The kw-hour consumption in October was 4900 and in November 4400, a very reasonable expenditure for the brilliant illumination of such a large store. With the old methods of lighting it might easily have been two or three times this amount to produce the same results.

As regards the method used for the general lighting, namely, a large number of units placed close to the ceiling, the results attained as to uniformity of illumination and freedom from annoying shadows by this method are certainly very satisfactory. This system is also decidedly decorative in its general effect. Almost as good results could probably have been produced by a smaller number of outlets to each ceiling panel, though at the expense of more decided shadows and less decorative effect. In view of all the contingencies as to various sizes and kinds of lamps which had to be provided for when the outlets were located, however, a smaller number of outlets did not seem advisable. The illumination is now ample for all present requirements. Should standards of illumination in competing stores be gradually raised so as to make more illumination desirable in this store after a few years, the circuit capacity is sufficient to substitute 100-watt lamps for the present 60-watt lamps in each outlet.

Lamp Posts vs. Street Arches.

By Albert Scheible.

One of the interesting tendencies of the past year in electric-light practice has been that toward a superior lighting effect in the business sections of the smaller cities. For this purpose two methods have been tried successfully at a number of points in the Central West. One consists in suspending incandescent lamps on stringers across the streets, these stringers being sometimes raised to a peak over the center of the street, and at other times supported by intermediate wires or by piping so as to have the lights form an arch. The other method endeavors to meet the same demand for display street lighting by installing closely-spaced lamp posts, using posts from 8 ft. to 14 ft. high and fitted with from one to five tungsten lamps, the tendency being toward the use of posts about 10 ft. high, with at least two or three lamps to the post. Judging from current reports, both of these methods of display lighting are quite effective in making the corresponding streets stand out brightly in comparison to other streets, so as to draw the trade to them, both from the rest of the city and from the surrounding country. Both types are also "contagious," as they readily stimulate similar lighting for other streets of the same cities and for adjoining places. Thus the recent experience in Michigan, where the adoption of display street lighting in one city is stimulating fully half a dozen neighboring towns toward the similar effects, shows how rapidly such a movement can spread.

Every case of such display lighting means considerable in the way of added revenue for the central station. During the coming year this proposition of having unusual lighting effects in the business streets promises to be a live topic at a great many points, and in most of these it may devolve upon the local central stations to advise as to the method of lighting adopted. Of course, the entire work of installation, including the lamps and supports, is usually paid for by the business men of the blocks thus illuminated, who sometimes band themselves together as a special association for that purpose; but the arrangement and spacing of the lights adopted generally depend on the advice given by the local central-station manager, who, therefore, has the chance to recommend either the use of arches or that of lamp posts. This is fortunate for the electric-light man, for his choosing between the two, or at least influencing the selection, may materially affect the resulting additions to his revenues from sources other than the immediate supply of current for this display street lighting. If the additional sale of current was to be limited to that needed for the unusual street lighting, the central-station manager might be indifferent as to the method adopted. However, there would seem to be a decided difference between the two plans in their effect on indoor lighting, and proper consideration of this should govern the advice given to the business men.

In comparing the two methods, the ease of installing the arches or suspended stringers of lamps and their generally lower first cost count for them, but they involve overhead construction, which is not in harmony with the tendencies of the time. They are more likely to damage in case of high winds, and the overhead wiring means another obstruction to the firemen. Then there is the more serious question of the comparative intensity of the light on the streets and walks, which really are the surfaces to be illuminated. The use of arches or stringers puts the lamps up high, so that a considerable proportion of the light is spent on the upper stories of the buildings, instead of its being practically confined below the level of the second story, as in the case of 8-ft. to 14-ft. lamp posts. This is particularly true with the comparatively horizontal light distribution for the tungsten lamps, unless reflectors are used over the lamps, and reflectors on suspended lamps would sway wildly in every wind.

While much of the light from the arch or stringer lamps is thus wasted as far as its intended effects are concerned, it also means an objectionable glare for persons living in the upper stories of such buildings. However, their interests are less important from the central-station man's point of view than the effect of the lowered intensity of street and walk lighting on the light needed for the show windows and stores. With the high suspended lamps, the intensity of illumination on the walks is generally low enough so that the present methods of store and window lighting are ample. But, if the lighting is done by lamp posts, the use of the same electrical energy will mean a so much more intense lighting of the walks and store fronts that the lighting of both stores and show windows must also be increased considerably. Of course, it would be poor policy to call attention to this feature until the display lighting is actually installed, after which time the comparative dimness of the interiors will furnish a ready field for additional lamps of higher candle-power than formerly used, and therefore for additional revenue to the central station.

Incidentally, the adoption of ornamental posts with underground wiring means an up-to-date form of construction, which in its permanency and artistic effect should appeal to the far-sighted merchant, in preference to the stringers or arches, no matter how appropriate these might seem for makeshift lighting during some brief celebration. Taken by themselves, the arches or stringers will bring an added revenue for the central station, but they cannot readily stimulate that additional revenue from indoor lighting which must follow the use of closely spaced lamp posts. Hence, the shrewd central-station man will do well to look carefully into the merits of the lamp-post system, and to advocate it in preference to the other method. It is more permanent, more artistic, more effective in throwing the light on streets and walks, less objectionable to the people upstairs and more dignified. In short, the lamp-post system is more worthy of the needed expenditure on the part of the merchants, so that the electrical adviser is amply justified in urging it upon the business men of his city. Then, if this involves some extra effort on his part, and possibly concessions in helping the merchants to a low cost of installation, he will be well repaid by the stimulus given to more intense show window and store lighting as soon as the added street lamps are installed.

Letters to the Editors.

The Condenser in Telephone Circuits.

To the Editors of Electrical World:

Sirs:—My attention was recently called to a paper by Lord Rayleigh on "Accoustical Notes" which appeared in the August number of the *Philosophical Magazine*. In this paper Lord Rayleigh gives a brief discussion on telephones, and suggests that the introduction of a condenser of suitable magnitude in the electrical circuit will probably improve telephony. He says: "Such experiment as I have been able to make did not exhibit any improvement in articulation as the result of including a condenser in the circuit. It is possible that the simple theory above stated is too much interfered with by complications such as eddy currents in the iron or hystereses in the action of the condenser. . . . It is probable that this subject has already received attention from those engaged in the endeavor to improve the telephone as a practical instrument; if not, I think it would be worthy of investigation."

I trust I will be pardoned in pointing out that in my paper on "The Influence of Terminal Apparatus on Telephonic Transmission," which appeared in the *Bulletin* of the Bureau of Standards, Vol. V., p. 231, I have discussed the same problem from the mathematical standpoint at some length, and I think that the theory is given there in quite complete form. My results show that the introduction of a condenser in the circuit ought to have a beneficial effect. We must wait, however, for experiment to give us the final and conclusive verdict of the case. I wish to bring this subject again to the attention of your readers with the hope that the knowledge that such an eminent authority as Lord Rayleigh thinks it a subject worthy of investigation may encourage and stimulate those who are in a position to do so to make an experimental investigation of the subject.

Washington, D. C. Louis Cohen.

Reform of Patent Laws.

To the Editors of Electrical World:

SIRS:—Apropos of the discussion in your columns on the need of reform in our patent laws, I should like to say that although I have never taken out an unassigned patent, yet I am a reader of the *Patent Office Gazette*, and as such am constantly impressed by the large number of trivial patents issued to people who will probably never get the amount of the Patent Office fees out of them, to say nothing of attorney's fees and other expenses.

A late number of the *Gazette* shows a patent granted to a certain party for a method of building brick chimneys which, judging from the illustrations and claims, consists simply of setting a row of bricks on the edge of the chimney on the side next the sloping roof. Such devices have been used ever since chimneys have been built, and even if the idea were new, how in the world will any man be able to collect royalties on such a patent? I think the inventor has been the victim of some patent attorney who advertises "a patent secured, or no charge." The Patent Office constantly plays into the hands of such people by taking for granted that because the records of the office do not show a device, it must be new. A patent is supposed to be granted for a "new and useful invention" and it seems to me that some discrimination should be exercised in the consideration of both of these qualifications.

COLUMBUS, OHIO. DUDLEY T. FISHER.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Output and Economy Limits of Machinery.—J. C. MACFARLANE AND H. BURGE.—A paper read before the (Brit.) Inst. Elec. Eng. In this paper the authors consider (a) the factor limiting the output obtainable from a given core-size of a medium-speed dynamo-electric machine; (b) the present-day practice with regard to this, and (c) the directions in which extension of this output-limit and economy in active material may be expected. The authors give numerous diagrams representing modern practice. One of these is reproduced in Fig. 1, showing the relation between output-factors and armature core dimensions for small, square direct-current dynamos. In the author's opinion the best machine is the one which complies

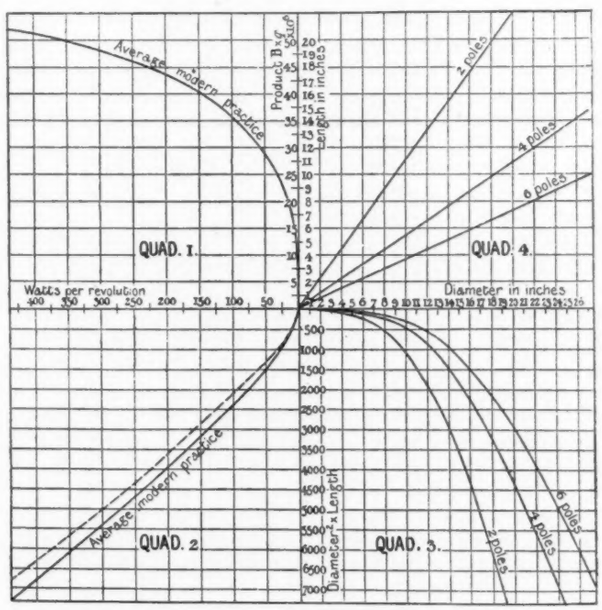


FIG. 1.—RELATIONS BETWEEN OUTPUT FACTORS AND ARMATURE CORE DIMENSIONS.

with the specified conditions with the least weight, size and cost. These advantages can be secured with only a slight sacrifice in temperature rise in direct-current machines, power factor in induction motors and regulation in alternators. The present instalment deals with direct-current machinery and with induction motors. The paper is to be concluded.—Lond. *Electrician*, Dec. 11.

Transformers.—A. P. M. FLEMING AND K. M. FAYE-HANSEN.—A paper read before the Manchester section of the (Brit.) Inst. Elec. Eng., giving some practical and theoretical considerations on transformers. The following types are used on a large scale: shell type with rectangular coils; circular shell type; core type with rectangular and with round coils. Typical designs were worked out for each type, and some figures were given as a comparison in the case of a 100-kva, 50-cycle transformer on the basis of iron-weight plus copper-weight multiplied by three as giving a figure approximately proportional to the cost of actual material. From the figures given it was seen that the difference in the amount of material for the four types was very small. The rectangular shell type is in all cases (especially for high copper space factors) slightly superior to the other types, while the circular-shell type for low copper space factors (that is, for high voltages) is somewhat inferior to the other types. The difference in electrical performance between the types is too small to be of importance in practice, though the difference in losses for the types is of the same order as the difference in the cost of the active material. With suitably designed windings any regulation can be obtained with any of the above types. For the shell types it will generally not be advisable to use the single concentric winding, as the regulation at low power factors will be too poor. The double concentric winding, however, gives fairly good results, but for practical reasons this arrangement of winding is very seldom used for the rectangular shell type. For the core type the single concentric winding gives fair regulation, and the triple concentric winding very good regulation. If the interleaved winding is adopted, the core type requires a larger number of coils than the shell types for obtaining the same regulation. The possibility of obtaining any reactance for any type of transformer is also of interest from the point of view of banking of transformers of different types, for it is evident from the figures given by the authors that it is possible in any type of transformer to arrange the winding so that it will operate in parallel with any given transformer of the same or of other type when the data regarding ratio, connections and impedance voltage for the existing transformer are known. As regards the cooling of the copper, the core types are better than the shell types. Especially is this so in the case of the circular core type. The cooling of the copper of the rectangular core type, and still more of the rectangular shell type, can be greatly improved when the sandwich winding is adopted by spreading the coils—that is, by bending them outward outside the iron. The authors then discuss the influence of special steel alloys of good magnetic quality on transformer design. If a special alloyed iron having approximately 60 per cent losses at the same induction and frequency compared with ordinary iron is employed, then the same maximum efficiency can be obtained at 46.5 per cent of the original weight. If the same efficiency is required at the same output as with ordinary iron, the product of induction and current density can be approximately 2.75 times as large as before. The authors then deal with the most economical ratio of copper and iron losses. In many hand-books it is stated that the ideal condition is to obtain

the maximum all-day efficiency. This, however, is not correct, as it is based on the assumption that the price per kw-hour is constant, independent of the load of the generating station. It must, however, be taken into account that the iron loss goes on always, and, therefore, corresponds to 100 per cent load factor, while the copper loss has its maximum when the load is maximum; that is, the copper loss increases the peak load, so that the kw-hour of copper loss will cost considerably more than the kw-hour of iron loss. To treat the subject mathematically in a simple manner, the authors assume that the load per day consists of full-load for a time of 24 a hours, corresponding to the load factor a (the rest of the time no load at all), and that the price per kw-hour alters with the load a as per curve, Fig. 2. The authors then show that the

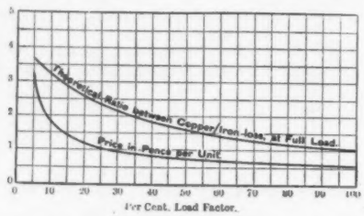


FIG. 2.—CURVES OF LOSSES AND PRICE PER UNIT.

theoretical ratio between copper and iron losses at full load is under these conditions best represented by the upper curve in the diagram. It is, however, good practice to make the ratio between copper loss and iron loss still smaller than the theoretical ratio. The authors, therefore, recommend that for ordinary voltages the ratio between copper and iron loss at full load should not be larger than about 80 per cent of the values given in the curve. The authors then compare different methods of cooling and point out that the depreciation of insulation and the aging of the iron depends on the temperature attained. This temperature should not for any length of time exceed about 85 deg. C. (German standardization rules 95 deg. C., A. I. E. E. 75 deg. C. at full load and 90 deg. C. at overload). With transformers of the forced-cooled type, the temperature of the cooling medium (air or water) can usually be easily kept low enough, and the air temperature of the transformer chamber is of secondary importance. In the self-cooled types, however, particularly for large units, special precautions must be adopted to ensure adequate ventilation of the transformer chamber. The best arrangement of the insulation is then discussed, and it is pointed out that in ensuring the best disposition of the insulation sight should not be lost of mechanical rigidity. In the extended discussion which followed, G. Harlow referred to the advance in transformers due to the use of alloy steels. Reductions in size and price, due to their use, are not possible for transformers having a frequency lower than approximately 30. Below this frequency it is not possible to increase the flux density as at present used in low-frequency transformers built with normal iron, owing to the excessive no-load current which results from any increase in the induction. Consequently what might be expected and was obtained in low-frequency transformers due to alloyed steel was a considerable increase in efficiency, but very little reduction in price. The rating with the alloyed steels is entirely limited by the large no-load current resulting when inductions higher than 14,000 are used, at which induction the no-load current is approximately 10 per cent. "Unfortunately the new alloyed steels are no better with regard to permeability than the steel hitherto used." Consequently, in order to still further cheapen the production of transformers having a reasonably high performance, the need of the transformer builder is an alloyed steel having the same losses as those recently produced, but having a much higher permeability at inductions between 14,000 and 20,000 lines per square centimeter.—Lond. *Elec. Eng'ing,* Dec. 10; Lond. *Electrician,* Dec. 11.

Lamps and Lighting.

Selective Radiation.—E. P. Hyde.—An abstract of an (American) Physical Society paper. The recent development in high-efficiency metallic-filament lamps has aroused new interest in the measurement of the high temperatures of glowing metals, and has raised the question as to whether the high efficiencies are due primarily to the high temperatures at which the filaments operate, or to a selective radiation, where by selective radiation is meant that the distribution of the energy in the spectrum of the radiating body at a given temperature is different from that of a "black body" at the same temperature. A recent photometric study of the relative properties of the newer metallic and the older carbon-filament lamps has led to the establishment of two new photometric methods by which a positive qualitative criterion may be had of relative selectivity of two radiating filaments. According to the first method if one filament is maintained at some definite voltage or current (i. e., at some definite temperature) and the voltage of a second filament is changed until the distribution of energy in the visible spectra of the two as determined by a spectrophotometer is the same, then if the two filaments had identical radiating properties, the energy curves of the two would be identical throughout the entire spectrum, and the temperatures of the two filaments would probably be the same. If this were the case, the ratio of the energy flow in the visible spectrum to the total energy flow radiated in the visible spectrum can be measured by determining the mean spherical candle-power and the total power radiated can be determined by measuring the power input, since there is no convection and very little conduction. If the radiating properties of the two filaments were identical, the watts per mean spherical candle under the above conditions would be the same for the two filaments. Conversely if under the above conditions the watts per mean spherical candle are different, one of the filaments must be radiating selectively with respect to the other. According to the second method, the two filaments are brought to the same distribution of energy in the visible spectrum in the same way as that employed in the first method. If, now, a determination is made of the percentage change in candle-power corresponding to 1 per cent change in power supplied to the lamp for each filament, these two coefficients of change of light corresponding to the 1 per cent change in power would be the same if the radiating properties of the two filaments were identical. Conversely if the two coefficients are different, one filament must be radiating selectively with respect to the other. In the actual use of these two methods the determination of the agreement in the visible spectrum of the energy curves of the two filaments has been made, not with a spectro-photometer as described above, but by means of a color match in an ordinary Lummer-Brodhun contrast photometer. If one lamp is maintained at some definite voltage and the voltage of a second lamp is changed until the color of the light radiated by the two lamps is the same, as observed in the photometer, it has been found that the spectro-photometric curves of the two filaments agree excellently. The color-match method is simpler and perhaps even more exact than the spectro-photometric method, provided there is no strong selectivity within the visible spectrum.—*Phys. Rev.,* December.

Metallic Filament.—A note on a recent British patent (20,223) of the "Z" Electric Lamp Syndicate and H. Zerning. Powdered tungsten trioxide is mixed with powdered zinc, and then the mixture is heated in an atmosphere of hydrogen. The zinc oxide formed is removed by heating with hydrochloric acid, and the remaining hydrogenous compound of tungsten is mixed with a binding agent consisting of nitrocellulose, amylacetate and castor oil. The liquid produced is squirted into filaments in the usual way. After the filaments have been heated in iron vessels, coated with a paste of zirconium hydride and amylacetate, they are sintered by passing a current through them in the usual manner.—Lond. *Elec. Eng'ing,* Dec. 10.

Electric Lamps Displacing Gas.—A note on a discussion before the Council of St. Marylebone on the proposal to adopt electric lighting in all the streets in the borough in which mains are laid. It was proposed to use the old gas lamp-posts, merely substituting two metal-filament lamps for the

present incandescent gas fitting in each lamp, and to connect each lamp-post separately to the ordinary service mains. The municipal lighting committee would pay an annual sum to the Electricity Department, which would bear all capital charges connected with the change-over. The Council adopted the scheme of street lighting by osram lamps. The cost is estimated at $43,250, compared with $44,090 for gas.—Lond. *Elec. Eng'ing,* Dec. 3 and 10.

Incandescent Lamps.—J. FINDLAY.—An abstract of a paper read before the Rugby Engineering Society in which the author dealt with the subject of carbon- and tungsten-filament incandescent lamps, and urged the view that it was uneconomical to run tungsten lamps at specific consumption lower than 1.25 watts per cp.—Lond. *Elec. Eng'ing,* Dec. 3.

Graphitized Filament.—A note on a recent British patent (5416) of the British Thomson-Houston Company relating to the manufacture of "metallized carbon filaments," and consists in impregnating the rough filament with sodium chloride previous to carbonizing. It is stated that filaments treated in this way are free from spots of high resistance, and are more uniform in cross-section.—Lond. *Elec. Eng'ing,* Dec. 10.

Generation, Transmission and Distribution.

Waste Heat of Gas Engines.—C. P. POOLE.—The author discusses the following three methods of utilizing the waste heat of gas engines for driving steam units: The first is to heat all of the jacket water with the exhaust gases, evaporate it into high-pressure superheated steam by means of coal-fired boilers, and use the steam in engines or turbines; the second is to follow the same course, but fire the boilers with gas taken from the same producers which supply gas to the engines; the third is to make and superheat as much steam as possible with the exhaust gases alone, using the steam in a low-pressure turbine. Each of these three methods is shown not to be practicable, the reasons being outlined. The author concludes that until an efficient low-pressure gas turbine is developed, waste heat from gas engines can be most profitably applied to heating. A hot-water heating system as an adjunct to a gas-power plant could easily utilize between 60 and 70 per cent of the exhaust heat and all of the heat on the discharged jacket water; such an auxiliary system would bring the gas engine nearer to the steam engine in applicability where sensible heat must be supplied by the power plant. However, a gas-power plant would not furnish as much heat as a steam-power plant of the same output.—*Power,* Dec. 8.

Draught.—An account of the discussion which followed the recent paper by W. N. Y. King on natural and induced draught. The basis on which a comparison of cost should be made was discussed, and several speakers emphasized the desirability for entirely redesigning a natural draught system when it is to be converted to induced draught. Several combined systems were mentioned.—Lond. *Elec. Eng'ing,* Dec. 3.—The original paper of King may be also found in Lond. *Elec. Review,* Dec. 11.

Firing Boilers.—F. R. WADLEIGH.—An article giving illustrations and suggestions on methods of firing stationary boilers economically, especially on the regulation of air supply, cleaning, kindling and banking fires, and on smoke prevention.—*Power,* Dec. 8.

Traction.

Brakes.—After the recent issue of the report on brakes of the committee of the (British) Tramways & Light Railways Association (already abstracted in the Digest) the (British) Municipal Tramways Association issued a report on the same subject. Although in some ways there is divergence in the points of view taken in the two reports, the final conclusions do not conflict. Both committees emphasize the importance of the human element, recommending the more thorough training of drivers, and realize the dangers of rails not properly cleaned; while the municipal committee inclines to the view that an ideal brake could be designed to meet all conditions, the report of the Tramways & Light Railways Association favors the consideration of each case separately. The practical result of the municipal committee's deliberations and investigations is that "a brake which can be applied instantaneously either by hand or power from a single lever to both rails and wheels is desirable, and so designed that the track shoes take the full allowed percentage of the car weight before the wheel brake comes into operation. Having regard to the average tramway conditions, this arrangement is most likely to fulfill best the general requirements. Tests and experience under service conditions will show what percentage of the total weight of the car may be efficiently transferred to the track shoes, and in this connection it must be remembered that one of the most important effects of such shoes is to clean the metals. A brake of this description will practically obviate the necessity of the use of sand for braking purposes and this is most desirable." An independent brake for pure emergency purposes is not considered to be desirable. Special automatic devices are necessary to prevent a car from running back on a gradient through failure of the supply of energy. So long as sanding apparatus is necessary for braking cars attention should be paid to the design of the hopper and the operating gear. The hopper should be of ample size. The gear should be of good mechanical design, and so arranged that both rails are sanded simultaneously, and that the driver should be able to apply sand at the rear end from his platform in the event of the car running backward. The committee also sees an advantage, for braking purposes, of steel tires as against chilled iron.—Lond. *Elec. Eng'ing,* Dec. 10.

New Single-Phase Railways Abroad.—Notes on several new single-phase railways to be equipped by German companies. The contracts of the Allgemeine Elekt. Ges. include one for the Padua-Fusina Railway, in Italy, 21.7 miles in length, with a trolley potential of 6000 volts at 25 cycles. Ten motor-cars will be used, each equipped with two 80-hp motors. Another line is the Lotschbergbahn, in Switzerland, on which a trolley e.m.f. of 15,000 volts at 15 cycles will be used. One locomotive, equipped with two 800-hp motors, will be employed. A coal-mine road at Menzelschacht, in Germany, 3.1 miles in length, will also be equipped with a locomotive with three 40-hp motors; 220 volts at 40 cycles will be used. The company also has a repeat order for the Blankenese-Ohlsdorf line for 25 cars, each to be equipped with two 180-hp motors. The present total single-phase motor rating of the roads in operation or under contract with this company amounted in November of this year to 42,480 hp. The latest contract of the Siemens-Schuckert Company is that for the Wiesentalbahn, between Basel and Schopfheim, in Germany, 34 miles in length, on which a trolley potential of 10,000 volts at 15 cycles will be used. There are 10 locomotives, each equipped with two 450-hp motors. The aggregate rating of single-phase railway motors of this company in operation and under contract amounted in October to 33,490 hp.—*Elec. Railway Jour.,* Dec. 19.

Electric Locomotives.—P. DAWSON.—A continuation of his long illustrated serial on electric traction on railways. The author having discussed the advantage of electric locomotives over motor cars, and having considered gearless locomotives, now passes on to the geared-motor type. The pros and cons of gearless as compared with geared locomotives are discussed, as are also the advantages which, under given conditions of operation, electric locomotives possess over the latest and most economical steam locomotives.—Lond. *Electrician,* Dec. 11.

Mountain Railway.—An illustrated description of the new mountain railway near Bozen, in the Tyrol, known as the Rittnerbahn. It is partly a rack railway, and whereas locomotives with shunt-wound continuous-current motors are used to take the cars up and down the steep gradient, the cars, which are equipped with ordinary series-wound traction motors, run by themselves on the horizontal portions of the line. The rack portion is on the Strub system. When descending the gradient, the locomotive motors return energy to the line. Energy for working the railway is supplied over a three-phase line from a water-power station some 20 miles away, continuous-current at 750 volts being obtained from a substation about half-way along the line.—Lond. *Elec. Eng'ing,* Dec. 10.

London.—Comparative statistical tables of the cost of operation on the different tube railways in London during the last year, with an editorial discussion of the subject.—Lond. *Electrician,* Dec. 11.

Installations, Systems and Appliances.

Electrical Industry in Germany; Proposed Tax on Electricity.—The complete issue is filled with an account of the recent meeting of the Berlin Electrical Society to protest against the proposed tax upon electricity and gas. The general secretary of the German Association of Electrical Engineers, G. Dettmar, criticises the proposed tax at length and in detail. He thinks that the tax will not bring the amount of money which is expected and that the cost of collecting the tax will be very high. A very serious matter is that the tax is based, partly at least, on the self-cost of generating electric energy, while no exact rules are given for finding a means of production. A tax on coal, peat, water powers, etc., would be much simpler. The collection of the tax will represent a means of supervision of the electrical industry by the government and many troubles are to be expected. The following statistical data were given relating to the first of April, 1909: There will be in operation in Germany at that date 1850 central stations, with a total rating of 1,100,000 kw. These stations sell per year about 900,000,000 kw-hours, representing a value of $40,000,000, of which $25,000,000 are for lamps and $15,000,000 for motors; the connections of the central stations amount to 1,400,000 kw, of which incandescent lamps are 630,000 kw, arc lamps 120,000 kw, and motors 650,000 kw. Besides the central stations there are in operation a great many isolated plants, the total rating of which is 6,000,000 kw, generating about 6,600,000 kw-hours per year. The connections of the isolated plants are 6,800,000 kw, of which incandescent lamps are 1,300,000 kw, arc lamps 700,000 kw and motors 4,800,000 kw. The total connections of incandescent lamps in Germany are, therefore, 1,930,000 kw, of arc lamps 820,000 kw, and of motors 5,450,000 kw. In the discussion the proposed tax was defended by private counsellor Dr. C. L. Weber, the "father of the proposed tax." He said that the government would have preferred a direct tax on coal, but did not propose it, as it was sure the parliament would reject this tax. Almost all other speakers spoke very strongly against the proposed tax. Dr. Beumer, M. P., also protested strongly against any tax on coal, peat or water power; raw materials should not be taxed. Several speakers, among them Kohlrausch, emphasized that the industry did not fear so much the expense as the troubles they would have with the agents of the tax commissioners. In view of the official protest of the German Society of Civil Engineers, the electrical engineers (as an interested party) will not make a special and elaborate appeal to the government.—*Elek. Zeit.,* Dec. 10.

Electrical Industry in England and Germany.—K. Perlewitz.—A communication claiming that Mordey's recent comparison of electricity supply in England and Germany is unfair because incomplete figures have been chosen for Germany (as the private stations have not been considered) and a wrong basis of comparison has been used.—Lond. *Electrician,* Dec. 11.

Electricity Tax in Germany.—A translation in abstract of the memorial presented by the German Society of Civil Engineers to the German Parliament, making an urgent appeal to reject the proposed electricity and gas tax.—Lond. *Elec. Eng'ing,* Dec. 10.

Contact Springs and Brushes for Switchboards.—R. Edler.—The first part of a long illustrated paper read before the Vienna Electrical Society. There is now a tendency toward standardization in the construction of contact springs and brushes for switchboards. The author recommends also the standardization of their dimensions. Rules are also given on their calculation. The paper is to be concluded.—*Elek. u. Masch.* (Vienna), Dec. 6.

High-Tension Insulators.—L. Conge.—An illustrated description of various high-tension insulators for overhead lines exhibited at the Marseilles exposition. Insulators of porcelain, glass and hard rubber made by different companies are described.—*L'Indus. Elec.,* Dec. 10.

Electrophysics and Magnetism.

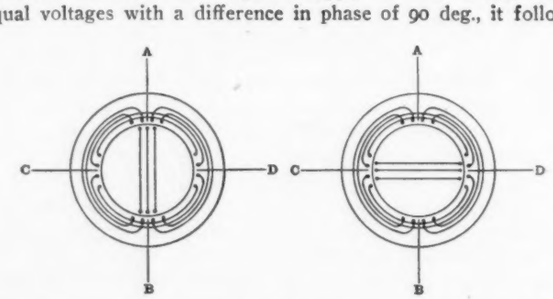
Properties of Current-Bearing Matter.—P. R. Heyl.—The fifth article of his serial on possible effects of electric current on various physical properties of matter through which the current is passing. This article describes some experiments on the effect of an electric current upon the refractive index of copper. The result is negligible. With electrolytic copper and sodium light, using a current density of about 50 amp per square centimeter, there is no change in the index as great as 2 per cent.—*Phys. Rev.,* December.

Discharges of Electricity from Glowing Bodies.—E. Rutherford.—A lecture before the Manchester section of the Brit. Inst. Elec. Eng., giving a review of our present knowledge of the discharge of electricity from glowing bodies and its relation to ionization phenomena.—Lond. *Electrician,* Dec. 11

Law of Induction.—F. Emde.—A continuation of his highly theoretical paper on the fundamental induction law. In the present instalment the author discusses the law of induction as expressed in the form of partial differential equations.—*Elek. u. Masch.* (Vienna), Dec. 6.

Units, Measurements and Instruments.

Phase-Shifting Transformer for Testing.—C. V. Drysdale.—One of the most troublesome operations in connection with the testing of wattmeters or watt-hour meters is the obtaining of a supply at any required power factor, and the varying of it in a suitable manner. The author recommends the use of a small phase-shifting transformer, which can be fixed on the testing table by the side of the instruments, and which can be adjusted instantly to any power factor by the operator who is taking the readings. In construction it is like an ordinary induction motor, having a primary or stator which is wound with two sets of coils at right angles when the supply is two-phase or single-phase, or with three sets of coils at 120 deg. for three-phase supply. This produces a rotating field in the center. A re-entrant drum winding with suitable tappings may also be used. The secondary is in the form of a cylindrical rotor, and is provided with a single diametral winding. In Fig. 3, which shows diagrammatically a phase shifter for a two-phase supply, *AB* and *CD* are the terminals of the two phases. The stator coils are equivalent to two diametral coils at right angles. In this the secondary coil is shown with its plane parallel to that of the primary coil *AB*. It, therefore, has an e.m.f. induced in it in phase with the potential difference on *AB*, while the second primary coil has no effect as the flux produced by *CD* passes the secondary coil without cutting it. If, now, the secondary coil is turned through a right angle, as in Fig. 4, it is evident by the same reasoning that the e.m.f. induced in it will be in phase with *CD*, and that *AB* has no effect. Since in a two-phase supply the two circuits have equal voltages with a difference in phase of 90 deg., it follows



FIGS. 3 AND 4.—DIAGRAM OF PHASE-SHIFTING TRANSFORMER.

that turning the secondary coil through 90 deg. shifts the phase of the voltage induced in it by the same amount, without altering the voltage. Since, also, the magnetic field is a uniformly rotating one, it is evident that the phase angle must increase uniformly as the rotor is turned, and by the same amount. The phase-shifting transformer enables the behavior

of any wattmeter or watt-hour meter to be ascertained almost at a glance if a reliable standard wattmeter is in circuit. It is then only necessary to observe the instrument under test on unity and zero power factor. Any error of calibration is shown by the reading on unity power factor at two frequencies, while the zero power factor test shows the error due to phase displacement in the meter. Fig. 5 shows the connection

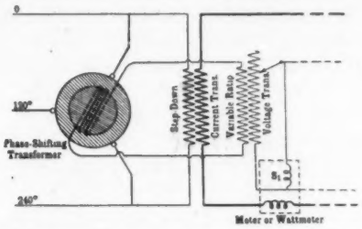
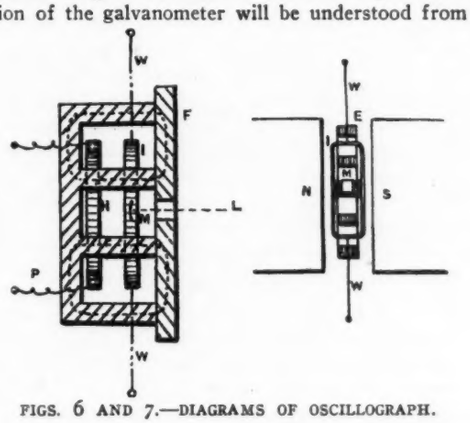


FIG. 5.—CONNECTIONS OF PHASE-SHIFTING TRANSFORMER.

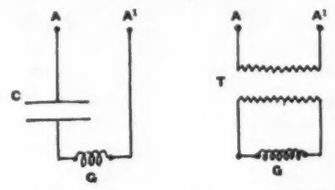
of the phase-shifting transformer for a three-phase supply system. The author finally describes tests of the transformer and its construction.—Lond. *Electrician*, Dec. 11.

Plotting Wave-Forms.—M. ABRAHAM.—An illustrated description of an instrument for projecting wave-forms on a screen. The instrument, which is simpler and less expensive than the oscillograph, consists of two parts. One of these is a special form of galvanometer, containing a swinging mirror, which is made to follow all of the variations of the current. The mirror swings back and forth, and would trace only a line of light upon the screen were it not for the fact that there is interposed between the mirror and the screen a second apparatus which serves to spread out the light coming from the mirror, so as to give the form of the wave upon the screen. The action of the galvanometer will be understood from Figs.



FIGS. 6 AND 7.—DIAGRAMS OF OSCILLOGRAPH.

6, 7, 8, 9 and 10. Suspended by two wires is a light aluminum frame *I* of rectangular shape, carrying in the center a concave mirror which measures 6 mm x 8 mm, and is consequently of a much larger size than is used in the oscillograph (Fig. 6). The aluminum frame is made to swing rapidly under the influence of the current. Around the frame is fixed an E-shaped piece of laminated iron *P*, which is provided with a covering piece *F* of the same metal, so as to form a closed magnetic circuit. Upon the same iron core, and lying next to the aluminum frame, is mounted a small rectangular coil of wire *H*, which is fixed and so disposed that when a current is passing in it the resulting magnetic flux will take the path shown by the dotted lines. The entire device, as shown in Fig. 7, is mounted between the poles of a permanent magnet *NS*. Should there be no current passing in the coil, the flux in the iron core will take a transverse direction in the latter. The construction in the galvanometer allows of the production of induced current in the swinging frame *I* in such manner that the movement of the latter will follow exactly the variations of the current to be observed. In order to obtain this result there is produced outside of the instrument an intermediate current which is in quadrature with the current (or e.m.f.) to be observed. In the case of an e.m.f., a condenser is disposed in series with the galvanometer, as seen in Fig. 8, and the whole is placed in the main circuit AA^1. For taking the current wave, on the other hand, the circuit is connected through the primary coil of a small transformer whose secondary coil is closed upon the galvanometer (Fig. 9). In practice two separate galvanometers are used, and these are placed side by side, so as to throw the two waves upon the screen. The intermediate current is thus sent into the fixed coil of the galvanometer, and this coil acts as the primary of a small transformer, whose secondary consists of the short-circuited aluminum frame. Were the permanent magnet not used in this case, the result would be a simple attraction of the frame toward the coil, without a rotation of the former. By employing the transverse flux from the permanent magnet, acting together with the flux which the coil tends to set up in the core, there is a resultant action which causes the coil to rotate about its axis, producing a deflection of the beam of light from the mirror. Under these conditions, the coil is made to follow all of the variations of the original e.m.f. of the current. The second part of the apparatus, known as the "synchronoscope," is used in order to spread out the beam of light which comes from the oscillating



FIGS. 8 AND 9.—DIAGRAMS OF CIRCUITS.

mirror, so as to give the wave-form upon the screen. This movement is proportional to the period of the wave. In Fig. 10 is shown the principle of the synchronoscope. The two galvanometers, one for the current and the other for the e.m.f., are mounted side by side on the right, and their mirrors are represented at M M^1. The mirror M receives a beam of light from an arc lamp by means of the adjustable mirror B which is fixed to the frame of the apparatus. This beam is reflected to the left and passes through the synchronoscope before reaching the screen. A revolving prism lies at the center of the synchronoscope and receives the two beams—the second beam coming from the mirror M^1 in the same way. The prism, which is totally reflecting, is caused to rotate rapidly in synchronism with the wave by means of a toothed wheel of soft iron, which is mounted so as to rotate between the poles of an electromagnet; the latter is connected to the source of current, and this combination makes a very simple and effective synchronous motor. The light which comes from the prism is not sent directly upon the screen, but is further reflected by a set of fixed plane mirrors which are disposed round the prism. These mirrors are placed so as to be about tangent to a parabola at whose focus is placed the center of the

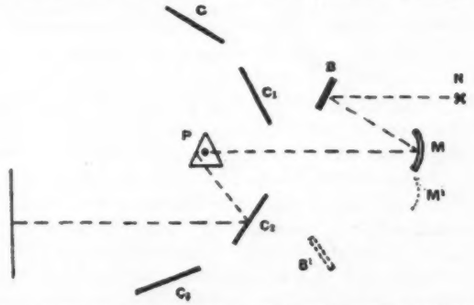


FIG. 10.—DIAGRAM ILLUSTRATING PRINCIPLE OF SYNCHRONOSCOPE.

prism, and they are shown at C, C_1, C_2, C_3. During the rotation of the prism, the beam from each of its faces is reflected upon the four mirrors in succession, and at each reflection the curve is thrown in the same place upon the screen, so that for one revolution of the prism there are 12 successive projections of the wave on the screen. In practice, the wave is thus traced

as a continuous line of light, and the e.m.f. and current waves have their proper relative positions.—Lond. *Elec. Rev.*, Dec. 4.

Manganine Resistors of Standard Resistance.—S. Lindeck.—A communication on the influence of atmospheric humidity on electric standard resistors. It is pointed out that in the climate of Berlin the periodic variation in the 1, 10 and 100 ohm manganine standard resistor was very small, while larger variations were found in 1000- and 10,000-ohm resistors, yet they were only one-fifth of those noticed by the Bureau of Standards in Washington. It is emphasized that 1000-ohm resistors are not so important as those of 1 ohm, which directly incorporate the unit. The writer agrees with Rosa and Babcock, of the Bureau of Standards, that not only is manganine very well adapted for resistors of standard resistance, but that the method of mounting the resistors and protecting them from the oxidation of the air or oil by shellac or varnish is very satisfactory, provided they are also protected from the effects of atmospheric humidity.—Lond. *Electrician*, Dec. 11.

Electrolytic Prepayment Meter.—A note on a recent British patent (23,450) of E. Schattner and R. Amberton. In electrolytic prepayment meters, the supply ceases when the level of the electrolyte falls below the level of one electrode. According to this invention an auxiliary electrode is connected in parallel with the above electrode, but through a resistor. The auxiliary electrode remains in the liquid after the main circuit is broken, and so the lamps are only dimmed instead of being extinguished.—Lond. *Elec. Eng'ing*, Dec. 10.

Apparatus for Cable Tests.—A description of an apparatus, devised by Delon and exhibited at the Marseilles exhibition, for producing a high direct-current voltage for cable tests. Its principle is as follows: If one pole of a sinusoidal e.m.f., with the effective value e, is connected to earth, the potential of the other pole varies between $+e\sqrt{2}$ and $-e\sqrt{2}$. The apparatus of Delon consists of a revolving commutator, which connects this latter pole of the e.m.f. with one conductor of a two-conductor cable at the moment when the potential is $\times e\sqrt{2}$ and connects it with the other conductor of the cable at the moment when the e.m.f. is $-e\sqrt{2}$. If the contacts are made at the exact moments the two conductors of the cable will assume a potential difference of $2e\sqrt{2}$. At the Marseilles exposition a transformer raises the alternating e.m.f. from 190 to 125,000 volts. By means of the special commutator a direct e.m.f. of about 300,000 volts is produced between the two conductors of the cable. The commutator revolves at a speed of 1500 r.p.m. The cable consists of two conductors, each of which contains 19 wires 2 mm in diameter. The two conductors are separated by 12 mm and are insulated with impregnated paper.—*Elek. u. Masch.* (Vienna), Dec. 6.

Measuring the Slip of Induction Motors.—C. F. Guilbert.—The author has modified the method of Seibt, who uses the contact device of Joubert, by means of which a circuit carrying an alternating current of the same frequency as the supply circuit is closed and opened once or several times during a revolution. The present author pastes a circular piece of cardboard on the end of the axle of the motor, a sector of the circle being cut out of the cardboard. A brush slides against this cardboard, and, therefore, makes electrical contact with the axle whenever it touches the cut-out sector. The brush is connected to a source of alternating current of the same frequency (for instance, a transformer) and a lamp or voltmeter, the circuit being closed through the axle. The author calculates the most favorable angle of the sector in order to obtain the best indications with the lamp or the voltmeter. Two methods are described.—*La Lumière Elec.*, Dec. 5.

Unusual Frequencies for Testing.—F. J. Moffett.—The writer refers to a case in which he had to test some single-phase apparatus designed for connection to a supply system at 80 periods. The highest periodicity which could be obtained from the works supply system was 50, and some means had to be taken to increase the frequency to the desired value. To the three-phase supply system the stator windings of a three-phase slip-ring motor were connected. The rotor pulley was belted to that of a variable-speed direct-current motor, and driven backward—that is, in the opposite direction to which it would have rotated under normal conditions, the slip being approximately 190 per cent. By adjusting the speed at which the rotor was driven it was possible to obtain from the rotor slip-rings exactly the periodicity required.—Lond. *Elec. Eng'ing*, Dec. 3.

Telegraphy, Telephony and Signals.

Telephone Exchange.—T. Devereux.—An illustrated description of a new British telephone exchange which is approaching completion in Cardiff, where hitherto the British Post Office and the National Telephone Company have been in competition. The new exchange has been built by the Post Office and is to be rented to the National Telephone Company (whose existing exchange is fully loaded) until the expiry of the company's license in 1911. A feature is a new subscribers' operator's cord circuit, in which a repeating coil is not employed. —Lond. *Elec. Eng'ing*, Dec. 3.

Miscellaneous.

Lightning Rods.—An account of a set of rules on the construction of lightning rods proposed by a committee of the Swiss Association of Electrical Engineers, consisting of Dengner, Blattner and Hubert.—*La Industrie Elec.*, Dec. 10.

NEW APPARATUS AND APPLIANCES

Chicago Electrical Show.

Final preparations for Chicago's January Electrical Show are well under way and the sale of space has been large. Notwithstanding the fact that the scheme of decoration employed last year was outlined as a permanent proposition, at a cost of $25,000, changes will be made for the decoration of the coming show which will cost approximately as much as was expended a year ago. Assistant Manager John J. Schayer, who has had charge of this year's show owing to the illness of Homer E. Niesz, feels particularly gratified with the results as they now stand. The list of exhibitors to date is as follows: Crane Company, Commonwealth Edison Company, Wagner Electric Company, Federal Electric Company, Cutler-Hammer Company, Pyro One-Light Sign Company, Shelton Electric Company, Lindstrom, Smith & Company, Western Insulation Company, National Battery Company, Perfection Vacuum Cleaning Company, Chicago Fuse Wire & Manufacturing Company, Electric Appliance Company, The Excello Arc Lamp Company, Kellogg Switchboard & Supply Company, The Stoltz Electrophone Company, Stromberg-Carlson Telephone Manufacturing Company, Mathias Klein & Sons, Telephony Publishing Company, Manhattan Electrical Supply Company, Ft. Wayne Electric Works, Electrical World, Benjamin Electric Company, *Electrical Record*, Central Electric Company, International Correspondence Schools, McRoy Clay Works, Chicago Pneumatic Tool Company, Robbins & Myers, Appleton Electric Company, United Pump & Power Company, Commercial Appliance Company, Electric City Publishing Company, Taussig & Babcock, Westinghouse Electric & Manufacturing Company, Autolectric Sign Company, General Electric Company, American Steel & Wire Company, National Acme Manufacturing Company, Hahl Automatic Clock Company, Swedish-American Telephone Company, Swedish Electric Vibrator Company, Popular Electricity Publishing Company, Peerless Light Company, Palm Engineering Company, Pacific Electric Heating Company, Duntley Manufacturing Company, National Automatic Advertising Company, Jewell Electrical Instrument Company, Roth Brothers Company, Cres-

cent Company, H. W. Johns-Manville Company, Red Cross Antiseptic Company, Northern Electrical Manufacturing Company, A. W. Kratz, Illinois Electric Renovator Sales Company, Hurley Machine Company, Murphy Electricity Rectifier Company, National Electric Lamp Association, Electrocraft Publishing Company, Electrical Testing Laboratories, American Electric Fuse Company, The Caloric Company, The Allis-Chalmers Company, North Shore Electric Company, Simplex Company, Cyclone Storage Battery Company, Electric Storage Battery Company, F. B. Badt & Company, Chicago Telephone Company, Mechanical Appliance Company, Western Electric Company, The Connersville Blower Company, Electric Cleaner Company, Pelouze Electric Heater Company, C. S. Neville & Company, Mears Ear Phone Company and National Carbon Company. The show will run from Saturday, Jan. 16, to Saturday, Jan. 30.

An Automatic Electric Air-Pump.

Where an air pressure of 30 lb. or less is required in considerable volume, a convenient service is given by the motor-driven air compressor of the Varwig Manufacturing Company, 120 Opera Place, Cincinnati, Ohio, as illustrated herewith. Such use ranges from beer pumps in saloons to air-brush work in draughting rooms. The outfits are furnished ready to connect to the electric circuit and to the same distributing air pipes used for any other system, by connecting the air outlet cock at the back of the storage tank. The working parts are enclosed in a strong brass globe, on top of which is a glass jar containing water through which the air is drawn before being pumped into the air tank. This method filters the air, leaving it free of all impurities.

AIR-PUMP.

The outfit is also provided with a 6-cp red incandescent lamp as a pilot light on the motor, showing when it is in operation. There is an automatic switch regulating the motor, so that the pump can be made to start up automatically when the pressure falls to a certain point. Hence a uniform pressure is maintained. Cleaning and oiling from time to time are the only matters requiring attention. The gage and all the brass parts of the device are well plated.

Self-Welding Wire Joint.

The Harvard Electric Company, Chicago, Ill., has placed on the market a copper self-welding wire connecting joint which is made, both as to length and weight, in accordance with the

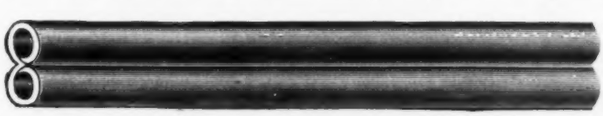


FIG. 1.—SELF-WELDING WIRE JOINT.

A. T. & T. specifications. It consists of two longitudinal metal barrels, the inner sides of which have beveled edges, as shown

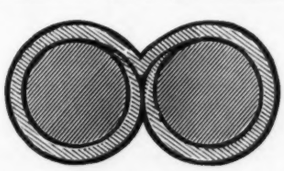


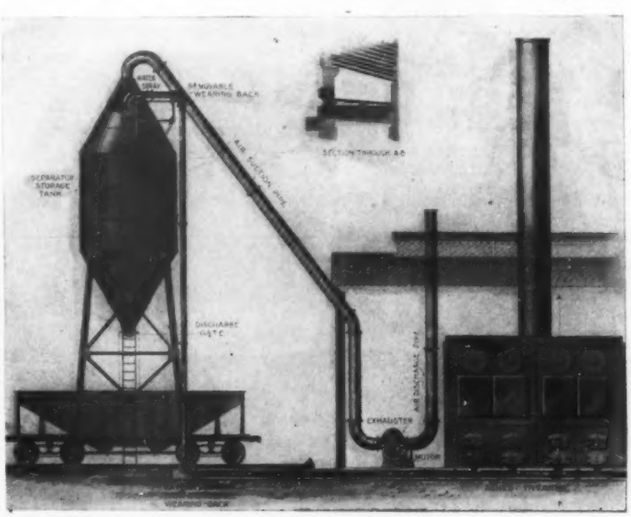
FIG. 2.—CROSS-SECTION OF WIRE JOINT.

in the accompanying illustration. These beveled edges serve as a guide for the rest of the sleeve by creeping around the inside of the barrels when they are twisted, allowing the two sides of the sleeves to overlap themselves as much as is necessary to conform to the inequalities of the wires which are being joined. When the joint is properly applied, the connection is said to be almost perfect and to possess great strength. Users of the joint claim that moisture cannot penetrate into it after it has once been twisted. The joint can be used satisfactorily in connecting wires which do not differ more than two gages in size.

Suction Conveyor for Removing Ashes.

For the removal of ashes from under boilers various mechanical conveyor systems are in use. Nearly all of these have moving parts which are subject to rapid deterioration owing to the character of the material which they handle. The Darley Engineering Company, of New York, manufactures a suction conveyor system which has no moving parts and in which every part is rigid save the motor and exhauster and with these the ashes do not come in contact. The conveyor pipe is made of iron or of steel, and as far as it is possible to do so, it is run in straight lines.

The separator, which is in reality an expansion chamber, also serves as a storage tank for the conveyed material. The separator is placed at the end of the conveyor run and serves to catch and hold the material until it can be drawn by gravity through an undercut gate into carts, cars or barges. The separator is usually built in a cylindrical form, but may be given other shapes and the material used may be steel, iron or con-



SUCTION CONVEYOR FOR REMOVING ASHES.

crete. The exhauster, which is similar in appearance to a centrifugal pump, consists essentially of a rotating impeller surrounded by a suitable case with an intake air opening at the center and a discharge opening at the circumference. For small, simple layouts the ordinary exhaust fan can be used, whereas for certain complicated and extensive work a cycloidal blower is usually adapted for the purpose. The exhauster may be either motor- or steam-driven. Just before entering the separator the conveyed material passes through a water jet located in the conveyor pipe. This jet serves to cool the hot material and also to eliminate all dust. In removing ashes the intakes are placed in front of the ash-pits or in any other desired location, and the ashes are hoed or shoveled from the ash-pits into these intakes, whence they disappear through the pipe line. The intake opening is slightly smaller in diameter than that of the pipe line, and when not in use a cast-iron cover is placed over the intake. Flanged fittings are used throughout in setting up the conveyor pipe and as the hardest wear comes on the elbows, a split elbow having an interchangeable wearing back of hard iron is used. The accompanying illustration shows a suction conveyor in use.

Remote-Control Oil-Switch.

It is generally conceded that for controlling alternating-current circuits having potentials above 600 volts, the oil type of switch is most satisfactory and practically meets the conditions of modern requirements. Fig. 1 herewith shows a remote-control oil switch brought out by the Central Electric Company, of Chicago. The switch is of the non-automatic, electrically-operated type, arranged to be opened and closed by means of tripping and closing coils actuated by a simple momentary contact push-button switch shown in Fig. 2. The switch is entirely self-contained, the operating coils, switching mechanism and oil tanks being mounted on a common support and secured by the same.

The switch will not open automatically upon overload unless arranged so that the trip coil is actuated by means of overload relays in turn operated by energy from the secondary of series transformers connected to the line. The laminated contacts are carried by a center support which in turn is operated by a soft iron plunger located within the fields of the closing and opening coils.

When the closing or upper coil is energized, the plunger draws the laminated brushes into close contact with the stationary connections and locks the entire mechanism firmly in position by means of a toggle which passes slightly beyond the dead center.

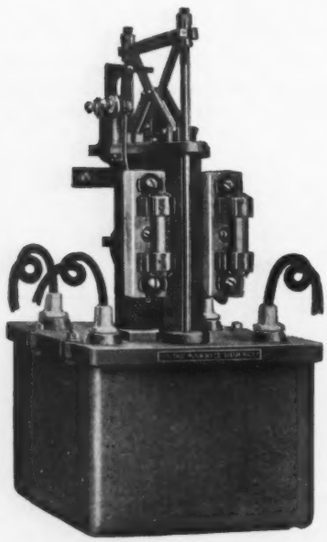


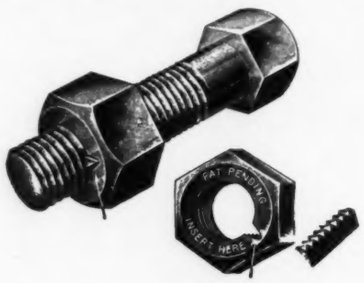
FIG. 1.—REMOTE-CONTROL OIL SWITCH.

FIG. 2.—PUSH-BUTTON SWITCH.

The toggles are so arranged that the greatest pressure on the contact is obtained when the switch mechanism is locked in its closed position. When the opening coil is energized, the plunger is drawn down and pulls the toggle across the center and releases the mechanism which immediately falls to the open position. The main contacts are provided with an arcing device so that the actual break takes place entirely on these tips and leaves the main contacts in good condition when the switch is again closed. The operating coils are only energized momentarily, small auxiliary contacts actuated by the operating mechanism opening the circuit as soon as the main contacts are in the open or closed position. The coils can be wound to operate from either direct- or alternating-current circuits and for various voltages up to 440. Circuits having potentials higher than 440 volts can supply the energy for the tripping and closing coils through transformers. The switch can, of course, be operated in many different ways, such as from relays controlled by time-limit devices, overload or underload devices, speed-limit relays, etc. The switch is also well adapted for use in opening the primary of constant-current transformers through the medium of special relays which act upon the breaking of the secondary circuit. For low-potential work the switch is operated without oil and has been used in connection with the wiring systems of large factories, churches, theaters, etc.

Vibration Lock-Nut.

The accompanying illustration shows a self-tighening and positive locking nut brought out by the L. S. Brach Supply Company, New York City. One of the main features of this nut is the fact that it will lock secure at any point on the bolt, and unless it is taken off in a proper but simple way the nut cannot be removed. The nut, it is claimed, does not distort or damage the threads of the bolt, but holds them with a positive grip by the teeth of a hardened key or wedge. The nut is similar to the usual nut and is made in cold or hot pressed material with either hexagon or square head. It has a longitudinal V-shaped slot holding a threaded, wedge-shaped key forming part of the nut. Because of the angle, this key plays no part in the operation of the nut while the latter is run on the bolt; but in an attempt to remove the nut the key is carried over against the other side of the slot forcing the teeth against the bolt so as to grip it with great force. The nut may be removed by inserting a pointed wire or piece of wood in the larger opening on the side of the key which will prevent the key from acting as a wedge and permit the removal of the nut in the usual manner. A peculiarity of the nut is that vibration tends to tighten it automatically, so that not only does this prevent the nut from working loose, but all lost tension caused by wear is taken up.



VIBRATION LOCK-NUT.

Reamer for Greenfield Single-Strip Flexible Steel Conduit.

The accompanying illustration shows the reamer for the Greenfield single-strip type of flexible steel conduit made by the Sprague Electric Company. It can be used for conduit in sizes from 5/16 in. to 1¼ in. For larger sizes than 1¼ in. diameter, a three-cornered scraper, or a common file, will be found satisfactory. This reamer can be used for rigid as well as for flexible conduit. Cutting Greenfield conduit with the ordinary hacksaw leaves only a small burr and this can be easily removed by the above reamer.

REAMER.

Electrically Operated Oil Switch.

The accompanying illustration shows a 30,000-volt, electrically operated oil switch which has been developed and placed on the market by the Kelman Electric & Manufacturing Company, Los Angeles, Cal. The switch is entirely self-contained and may be installed in any way desired by simply placing on the floor and connecting up, or in galleries, or in brick or concrete compartments as may be required.

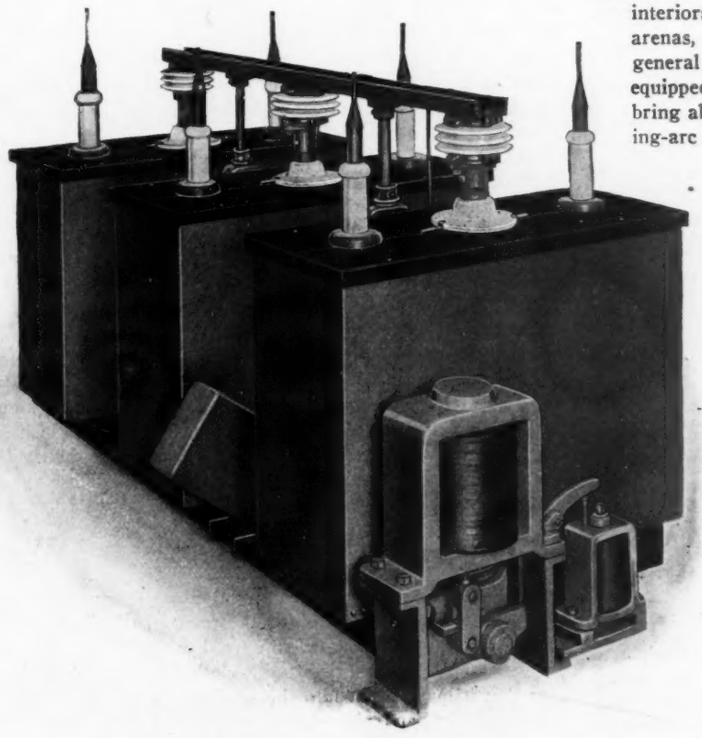
The operating solenoids are wound for 110 volts, direct current, the closing solenoid requiring approximately 2300 watts and the opening solenoid approximately 300 watts. The switch is opened by means of springs placed on the guide rods, the opening solenoid being required simply to release the lock which holds the switch in the closed position.

The switch is made non-automatic or automatic as may be required. In the latter case the automatic overload release is actuated by means of series relays which operate by closing the circuit of the opening solenoid, thus tripping the switch. These relays are mounted on insulators which may be installed in any convenient manner. The laminated iron cores are attached to one end of a rod of treated wood, to the other end of which are attached the contacts which serve to close the circuit of the operating solenoid. This wooden rod, in addition to the insulating tube within which the core operates, provides ample insulation at this point.

The switch is controlled by means of a small single-pole, double-throw switch placed on the switchboard or operating table. Mounted on the switch and operated by it is a small switch which automatically opens the circuit of the closing solenoid as the switch is closed. In the automatic switch the circuits of the operating solenoids are so arranged that if the switch is closed on an overload or short circuit, it will immediately open and will remain open until such time as the operator desires, even though he still holds his control switch in the closing position; in other words, the switch cannot "pump in and out on a short." In the event of failure of the operating current while the switch is in an intermediate position in the act of being closed, it will immediately return to the open position. Signal lamp contacts are provided to indicate the open or closed position of the switch by means of colored lights.

The fixed contacts are secured to porcelain insulators which are mounted on a wooden support placed well down in the oil. The movable contacts are of the knife-blade type and form part of a simple pantograph by means of which a horizontal break is secured, which occurs at a point in the tank which leaves two-thirds of the total volume of oil above the break. This form of contact and switch mechanism has been successfully used for the past five years in Kelman switches. The covers for the oil tanks are made in two pieces, either one or both of which may be readily removed, for purpose of inspection of the contacts, without disturbing any other part. The entire mechanism in each tank is so arranged that it can be easily lifted out without disturbing the other tanks or without drawing off the oil.

These switches are made in sizes from 15,000 to 100,000 volts, either non-automatic or automatic as may be required.



ELECTRICALLY OPERATED OIL SWITCH.

Flaming Arc Lamp with Inner Prismatic Globe.

As is well known, the ordinary flaming-arc lamp with inclined electrodes gives a distribution of light which is rather downward than outward, the maximum being obtained at an angle of about 30 deg. in a vertical plane and the greatest amount of light being radiated between the angles of 15 deg. and 75 deg. While such a distribution renders the flaming-arc lamp with inclined electrodes suitable for illuminating restricted areas in front of stores, etc., it does not make the lamp especially suitable for general street lighting, where a better distribution at points distant from the lamp is needed. A better distribution is also required for general illumination of large interiors, such as storage warehouses, covered docks, arenas, etc. In order to render its lamps suitable for general lighting the Excello Arc Lamp Company has equipped them with prismatic inner globes which bring about the desired distribution. Fig. 1 shows a flaming-arc lamp equipped with an inner prismatic globe, the outer globe being removed for the purpose of illustrating the inner globe more clearly. In order that a comparison might be made between the ordinary flaming-arc lamp and one equipped with an inner globe, tests were made for the company by the Electrical Testing Laboratories. For this purpose a 10-amp, direct-current lamp, with positive electrode of 10 mm and negative electrode of 9 mm in diameter,

FIG. 1.—ARC LAMP WITH PRISMATIC INNER GLOBE.

was used. Two globe equipments were supplied; the first consisted of an 11-in. clear-glass globe with ventilating ash tray at the bottom; the second consisted of a clear-glass 11-in. globe with ventilating ash tray at the bottom and an inned globe approximately 5½ in. in diameter and 4¾ in. deep, having a 2½-in. aperture at the bottom. This inner globe, from the bottom to a point within 2 in. of the top, was provided with horizontal glass ribbings of prisms calculated to redirect the light rays.

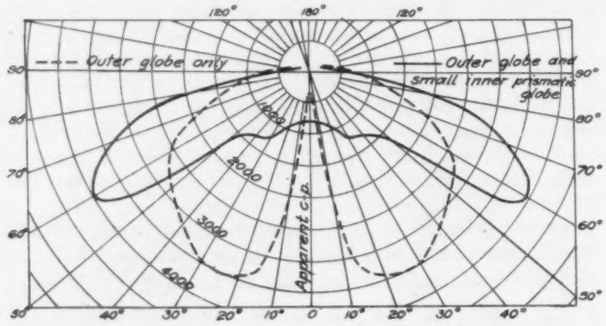


FIG. 2.—DISTRIBUTION OF LIGHT FROM FLAMING-ARC LAMPS.

The lamp was permitted to burn for about two hours before any tests were undertaken. It was operated upon one side of the three-wire system, the average line voltage being 118 volts. By means of an adjustable external resistor, the current through the lamp was maintained at about 9.5 amp. The light distribution was determined by means of the Matthews arc-lamp photometer having mirrors located at 15-deg. intervals. The vertical plane throughout which the distribution was investigated is one located approximately at 45 deg. to the vertical plane of the arc stream. In the photometric measurements a Bunsen photometer with Leeson disk was employed, and an incandescent electric lamp was used as the standard of candle-power. At each point at least 100 individual settings were made. The results shown below are average values obtained from a series of such settings:

DISTRIBUTION OF LIGHT.

Angle in vertical plane.	Flaming arc with clear prismatic inner and clear glass outer globes. Apparent candle-power. Max.	Avg.	Min.	Flaming arc with clear glass outer globe. Apparent candle-power. Max.	Avg.	Min.
165	...	...	...	66	64	52
150	153	144	129	109	98	89
135	169	161	152	148	140	130
120	155	147	126	206	177	150
105	265	200	175	298	268	237
90 horiz.	548	440	300	732	638	528
75	3,320	2,735	2,140	1,665	1,505	1,400
60	4,870	3,970	3,240	2,890	2,585	2,435
45	1,656	1,404	1,136	3,140	3,005	2,640
30	1,384	1,212	1,028	3,745	3,460	2,490
15	964	861	735	3,515	3,240	2,900
0	943	836	748	280	248	210

SUMMARY OF TEST RESULTS.

Amperes	9.5	9.5
Volts, line	118	118
Volts, terminal	57	58
Volts, arc	48	49
Watts	1,115	1,122
Watts, terminal	539	551
Watts, arc	454	465.5
Mean spherical cp	1,135	1,122
Mean lower hemispherical cp	2,120	2,285
Watts per mean spherical cp-terminal	0.475	0.441
Watts per mean spherical cp-arc	0.400	0.371
Watts per mean lower hemispherical cp-term'l	0.254	0.241
Watts per mean lower hemispherical cp-arc	0.214	0.204

The results of light distribution, as shown in the table, are presented diagrammatically in the curve. This shows at a glance the difference in the distribution of the light from the lamp fitted with a prismatic inner globe as compared with the same lamp not thus equipped.

Electrically Operated Mailing Machine.

A labor and time saving device which finds a wide application in business houses, etc., in handling the outgoing mail, is the electrically driven envelope sealer, stamper and counter illustrated herewith. The machine will readily perform its various operations on 150 letters per minute, and may be speeded up to turn out considerably more when required.

The letters in bunches are held against an automatic feed, which permits only one envelope at a time to pass its flap over a metal disk which revolves in water. As the envelope advances, the stamps are fed forward, cut off, moistened and rolled upon the passing letter. After the envelope flap is moistened and the stamp simultaneously attached, the letter passes between a series of rolls under pressure, and then emerges and is automatically stacked. A counter records each stamp as it passes upon the envelope, and thus furnishes a check upon the amount spent for postage. Moreover, the stamps cannot be removed from the machine except by the clerk to whom the key is entrusted.

ELECTRICALLY OPERATED MAILING MACHINE.

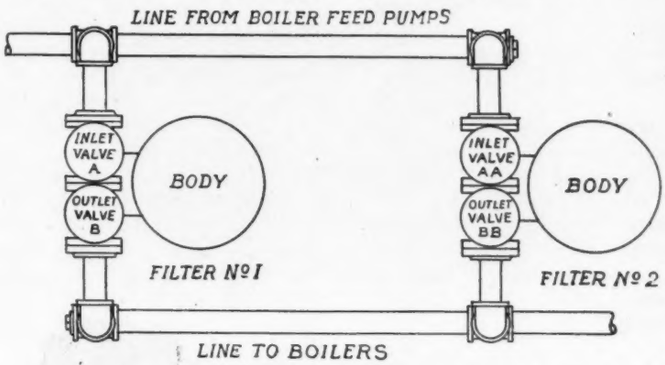
The source of power being furnished by an electric motor, no mechanical labor is involved in the operation of the machine except the feeding of the letters in bunches. The motor is attached by a flexible lamp cord to an ordinary electric lighting socket, and to start the machine it is only necessary to turn the switch. There is no interruption until the work is completed, and the number of envelopes sealed and stamped in a given time is much greater than is possible in the case of a manually operated machine.

The Schermack Mailing Machine Company is the manufacturer of the sealer, stamper and counter illustrated, and the Westinghouse Electric & Manufacturing Company furnishes the electrical attachments. Only a ⅛-hp motor is required for the latter, so that the cost for current is negligible.

Linen Terry for Clarifying Feed Water.

Linen terry has long been recognized in marine practice as a superior filtering medium for the removal of oil, grease and other floating impurities in the feed water. In addition to excellent filtering qualities, terry cloth has the added advantage that it may be put into the smallest space, cleaned without difficult labor, and the cloths may be used over and over. The cartridge shown in Fig. 2, from a Blackburn-Smith feed-water filter and grease extractor, is an effective method of using the terry, which also permits easy removal for cleaning. The filter proper in this case consists of cartridges similar to that shown, the size and number of each being determined by the amount of water to be filtered per hour. Each cartridge consists of two concentric, perforated brass cylinders, the lower one of the inner one being set into the partition which separates the filtering and outlet chambers. The filtering me-

dium is shaped somewhat like a stocking, the closed end being drawn down tight over the cylinder, the rest reversed over the outer cylinder and the end clamped at the top by a brass cap. As the water passes toward the center of the cylinders and into the outlet chamber it must pass through the two layers of terry. Any impurities not caught by the first layer are sure to be retarded by the second. A spare set of cartridges can always be kept in readiness, so that they may replace the fouled cartridges within the filter at a moment's notice. Renewing the filtering media is accomplished by lifting the cover from the filter-chest, pulling off the outer cylinder and the foul cloth from each cartridge and slipping on the clean cartridges as shown in the illustration. The frequency of renewing the terry cloth in any filter using this material varies according to conditions peculiar to each plant, and can be determined by

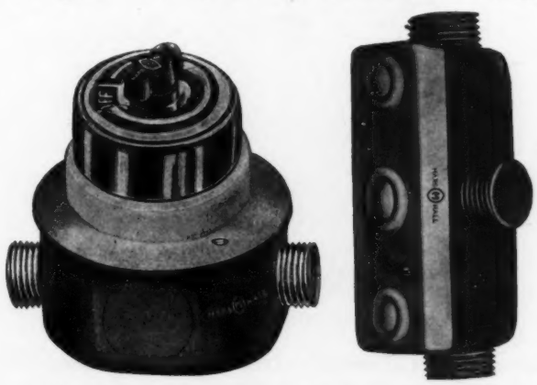


FIGS. 1 AND 2.—CONNECTION OF APPARATUS AND CARTRIDGE OF FEED-WATER FILTER.

a short operation of the filter. Foul terry cloth can be boiled in soda and kept in readiness for the next cleaning. Terry cloth filters are usually so made that they can be by-passed, and the cleaning operation can be completed without shutting down the plant. If the water is exceptionally dirty, it may be worth while to use two filters, so arranged that either can be operated without reference to the other. Fig. 1 illustrates two Blackburn-Smith feed-water filters so piped that each may be thrown into service or cut out at will; thus one filter may be cleaned while the plant is running and the other is supplying clean water to the boilers. The filter is made by James Beggs & Company, New York, who can also supply the terry cloth.

Conduit Fittings.

For the system of wiring employing exposed conduit for factory and many outdoor structures, a number of fittings have been designed. In many instances the number of fittings is



FIGS. 1 AND 2.—APPLICATION OF CONDUIT FITTINGS.

very large, making it difficult for a contractor to figure on a job with any certainty of knowing exactly what fittings he would require. To overcome this trouble, the Marshall Electric Company, of Boston, Mass., has designed a universal steel fitting shown herewith. A knockout box about the size of the pipe coupling has three knockouts on one side, one in each end, one in the bottom and one in the side opposite the three knockouts. These knockouts are removed by the constructor as he comes to the place where the fitting is required. When the hole is knocked out, a square-headed nipple is inserted. This nipple will not turn in the box and a pipe with a coupling on the end may be screwed into this nipple, or the fitting with the nipple

FIG. 3.—NIPPLES.

FIGS. 4 AND 5.—KNOCKOUT BOXES.

may be turned into the pipe coupling. The box is provided with the usual covers. For the accommodation of switches, rosettes, sockets and receptacles, the octagonal or round box is used. This box has a flat face to make a tight joint against the pipe coupling, and the upper flange is turned over so that the cover may be secured by two lugs which set under this flange by simply tightening up the screws.

Plain metal covers, porcelain covers adjustable to one, two and three wires are provided, as well as the universal cover applicable to all switches, rosettes and receptacles. This cover has two pivoted lugs tapped for screws, which can be adjusted in or out by taking hold of both at the same time. Two segments of metal are partly knocked through so that if it is desired to enlarge the hole in the cover they can be removed with a hammer or with a pair of heavy pliers. Being made of steel, this line is not subjected to the breakage of the cast-iron fittings.

Boiler Compounds.

BY A. EUGENE MICHEL.

The majority of scale-forming and corrosive elements in feed water can be most effectively and economically prevented from doing harm by the careful use of a scientifically prepared boiler compound. Scale-forming elements can be dealt with in three ways: treatment of feed water before it enters the boiler; treatment within the boiler, or scale removal at periodic intervals.

The first two methods apply also to corrosive elements, which must be rendered absolutely harmless as soon as discovered, if the boiler is to be preserved. If scale and corrosion are to be prevented by external feed-water treatment, there is required additional apparatus in the form of a purifier, filter, settling tank, separator, or a combination of these which may or may not accomplish the purpose thoroughly and completely. If, on the other hand, the feed-water impurities are permitted to form scale which gets thick enough to manifest itself, an initial expenditure becomes necessary for cleaning apparatus, which in itself is a source of repair expense.

The use and action of boiler compound is quite a contrast

to the drudgery of scale removal, or other preventive methods. As compound acts entirely within the boiler, no other apparatus save a feeding device is required. This, as a rule, may be obtained free from the manufacturer of the compound. The engineer has only to spend a few minutes each day in renewing the supply of compound to keep the heating surface clean and at highest efficiency, and the boilers need only be blown two or three times a day, and occasionally washed out with a hose. There is no investment save the cost of the compound. If the compound is correctly prepared and used, there will be found, upon emptying the boiler, nothing but a little soft mud which may be washed away with water, or if allowed to dry, may readily be blown away as dust. But success with any boiler compound depends upon its adaptability to the feed water, and upon using the right quantity to accomplish the purpose. It is simply the neglect of these conditions that causes dissatisfaction with compounds. Water carrying a large percentage of impurities requires a proportionately large percentage of chemicals to render these impurities harmless, while other water might require a lesser amount of chemicals.

There are elements that will dissolve the scale, although their use is not practical. Soda ash, acid salts, free mineral acids, caustics, acid compositions, etc., are sometimes offered, disguised by coloring matter. Caustic soda or slacked lime, for instance, will control the corrosion and deposit, but the quantities required would be enough to convert all the boiler water into a foamy mass which would cause trouble. Again, the same mixture is oftentimes used for all conditions. Just what this might mean may be judged from the difference between the impurities in the following two waters:

Sample No. 1.

	Grains per gal.
Solids	22.829
Organic and volatile matter	1.011
Sodium chloride	3.415
Sodium carbonate	11.170
Sodium sulphate	1.450
Calcium carbonate	2.452
Magnesium carbonate	1.516
Iron oxide and alumina	.714
Silica	1.101
Free carbonic acid	6.511

Sample No. 2.

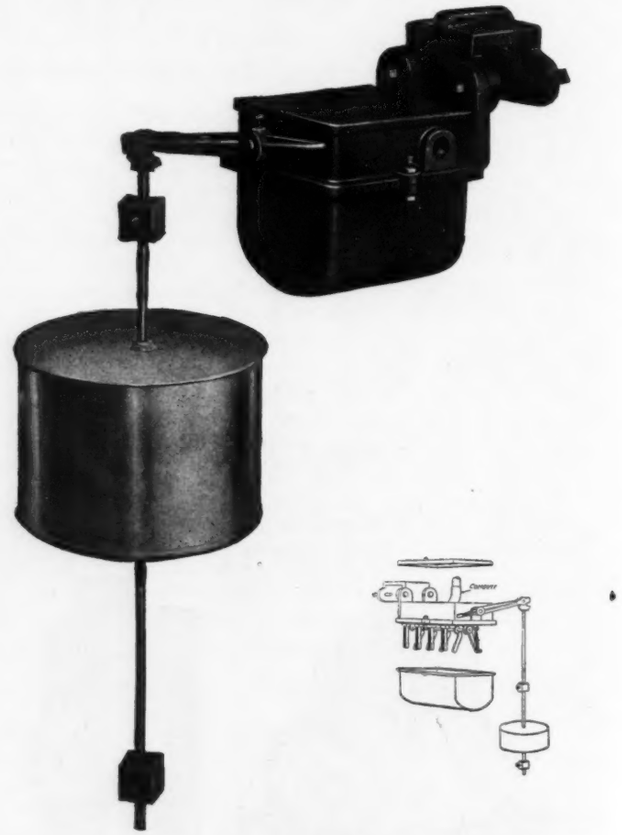
	Grains per gal.
Solids	39.923
Organic and volatile matter	6.235
Sodium chloride	5.239
Sodium sulphate	4.101
Calcium carbonate	2.145
Calcium sulphate	16.038
Magnesium carbonate	1.923
Magnesium sulphate	4.242
Free carbonic acid	14.141

The above samples are chemically opposite. No. 1 is of an alkaline nature and under the influence of boiler heat and pressure would tend to foam and prime. The scale from this water would be like mud. As the water inside the boiler would be converted into steam, the sodium salts would concentrate in solution in the water, increase the gravity of the solution, and retard free steaming. If this water was treated with a boiler compound containing alkalis, the harmful constituents already present would do still more harm and increase the foaming tendency. Sample No. 2 tends to form a heavy crystalline scale, so hard that if struck with a hammer it would chip like porcelain. In addition to chemicals required to neutralize the various calcium and magnesium salts in solution, the compound should, in this case, show an alkali reaction.

It is peculiar that if the two waters were mixed, a heavy precipitate due to the action of the impurities of one upon those of the other would occur and greatly improve both waters. This is just what the compound does, as well as rendering the precipitate non-adhesive. It is clear that the compound should contain the right amount of each of the right constituents to do its work well. It is also evident that this is a matter of individual investigation for each plant, by a competent chemist, and then of following his instructions carefully in applying the remedy he offers. There is nothing to fear from the use of boiler compounds when these conditions are heeded and the Bird-Archer Company, of New York, guarantees its compounds. A competent staff of chemists analyzes the water or samples of scale from the plant where the compound is to be used before giving a remedy. Explicit instructions go with each shipment of compound, and where these were followed, there has been no difficulty in preventing corrosion or scale formation. It is even practical to use compound to dissolve old scale of long standing, and this can be done without in any way injuring the boiler, its fittings, packing, gaskets, or cutting the cylinder lubricants. A properly prepared compound will not cause the boilers to prime or foam, and it will not contaminate the steam in any way to effect products which come into contact with it.

Tank and Sump Switch.

The Smith Electric Company, of New York City, has brought out the tank and sump switch shown herewith. The operation and interior mechanism of the switch are quite simple. The switch is brought into action by the pressure of the float against either of the stops, the pressure being communicated to the knife blades by the rod suspended on the rocker arm. The snap action of the switch is accomplished by a spring fastened at one end to a pin on a lever carried by the same shaft as the rocker arm. As the pin moves in either direction past the center of the rod carrying the blades, the spring causes the blades to move with a snap. The switch is weatherproof and can be made watertight if desired. The stops on the rod upon which the float moves can, of course, be set at any desired positions so that the time of opening and closing the circuit may be varied to suit conditions. The switches are made with one, two, three and four poles, the latter being intended for two-phase systems when the requirements demand the opening of all mains. Where it is necessary to take care of high voltages, the switch is made oil break.



FIGS. 1 AND 2.—TANK AND LAMP SWITCH AND DETAIL OF SWITCH MECHANISM.

The Cooling of Transformers.

The method employed for cooling transformers is often dictated by the local conditions, whereas, in some installations the method is a matter of choice. However, it is the practice of one manufacturing company to build self-cooling transformers rated at from 50 kw to 150 kw for use in plain boiler-iron tanks; boiler-iron tanks with radiating strips are used with transformers rated at from 50 kw to 250 kw, while corrugated tanks are employed with self-cooling transformers of from 50 kw to 500 kw in rating. These transformers are wound for e.m.f. not exceeding 50,000 volts. Oil-immersed, water-cooled transformers for any voltage are built in any

FIG. 1.—TRANSFORMER COOLING COIL.

rating above 100 kw. Air-blast transformers are built for e.m.fs. not exceeding 25,000 and in ratings from 60 kw to 1000 kw.

The cast-iron tanks used by the Wagner Electric Manufacturing Company are made of a special foundry mixture. When received from the molding floor the tanks are sandblasted, and then chemically treated to fill the pores in the iron in order to prevent leakage. The corrugated tanks are made of leaded sheets (terne-plate), and the boiler-iron tanks are made of

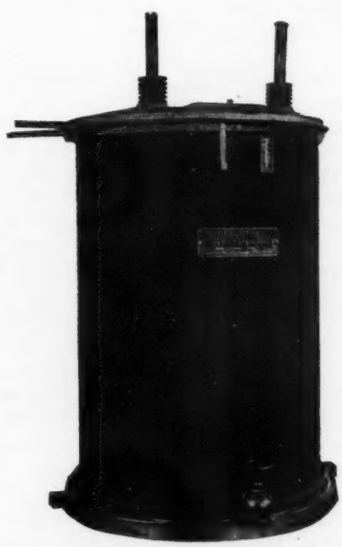


FIG. 2.—TRANSFORMER.

steam boilerplate; both types are provided with cast-iron bases and tops. The cast-iron base is provided as a support to the tank proper, but is in no way depended upon to hold the oil, as it is difficult to make an oiltight riveted joint between a boiler-iron shell and a cast-iron base. The tank proper—a self-contained cylindrical shell, riveted and calked to a standard boiler head forming the bottom of the tank—is arranged to hold the oil. A cast-iron ring is riveted to the top of the tank, and the transformer cover is bolted thereto, with a dirt-proof and moisture-proof casket between the ring and cover. The tanks, after completion, are filled with a light, volatile oil, and tested for leaks for several days.

The tanks of large oil-immersed transformers are equipped with oil gages and thermometers, for indicating the oil level

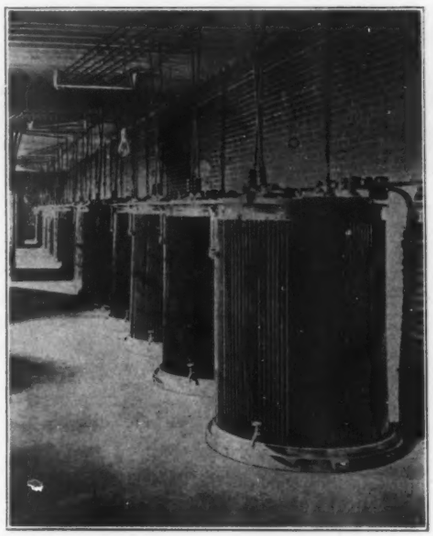


FIG. 3.—TRANSFORMERS IN SERVICE.

and the operating temperature of the transformer, respectively.

In the air-blast transformers the cooling air, delivered by a fan blower, is supplied through suitable ducts and controlled in amount by regulating the speed of the fan, or by adjusting the gate in the base of the transformer itself. Instead of simply admitting the air at the bottom of the transformer and allowing it to escape at the top after passing up through the transformer structure, in the Wagner air-blast transformers the air passages are so arranged that the cooling air, after passing up through the coils, is deflected downward again so as to traverse the iron circuit, and then allowed to escape through a separate passage in the base.

The water-cooled transformers are so designed that in case of necessity the core can be removed from the case with very little effort and without disturbing in any way the location, connections or arrangement of the cooling coil, or of the feed or intake pipes to the latter. The cooling coil is made of seamless copper tubing.

The magnetic circuit of Wagner transformers is of special alloy steel, which it is claimed practically eliminates aging, as well as materially reduces the first cost.

In order to make it impossible for the transformer to get out of position in the case during transportation, it is bolted through the shell to the cast-iron base, thus relieving the shell of all strain and at the same time providing a rigid form of construction.

It is claimed that the transformers illustrated in Fig. 3 have been in service for 10 years without requiring one dollar for repairs.

Rotary Motor for Scaling Boilers.

The greatly increased importance now assigned to heating surface effectiveness, as necessary to steam boiler economy, has directed the efforts of engineers toward improved means of cleaning scale from boiler tubes. This has resulted in a new air-driven or steam-driven rotary motor adaptable to many uses other than tube cleaning, for which it was originally designed and is specially suited. It is now generally accepted that water-tube boilers are best cleaned by the very rapid rotation of a cleaning head or tool passing through the tube in

advance of a cylindrical body or gage that fits the cleaned tube and will not move forward in the tube until the scale is cleared away in front of it. A high speed of rotation is usually depended upon to produce either a rapid succession of rotary blows from a hinged tool, or rotary toothed cutters are forced against the scale in the tube by the centrifugal action due to their rotation. The earlier devices consisted of a motor outside the boiler driving the tool within the tube through a jointed or telescoping shaft. The high speed required and con-

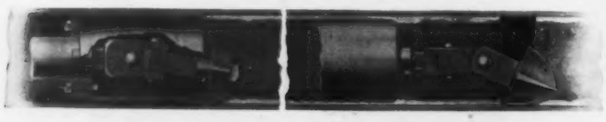


FIG. 1.—NEW AND OLD WAY OF CLEANING TUBES.

siderations of space and convenience practically prohibited the use of a long shaft in favor of a high-speed motor carrying a cleaning tool ahead of it, the motor and tool together (on the end of a hose) passing through the boiler tube. This is now the form of nearly all tube cleaners. There are several other devices for the purpose, but the total number of them in actual service is comparatively small.

In fire-tube boilers the scale is on the outside of the tube and the problem is to knock it off the tube without injury to the tube itself. This now appears to be accomplished most thoroughly and safely by a suitable head rotated inside the tube at the proper speed to give a hammering action. With this rotary motion there is no danger of striking continually on one spot of the tube and damaging it. In short, the fire-tube cleaner comprises the same motor, somewhat differently equipped, as used in water tubes and for cleaning both water-tube and fire-tube boilers, the requirement is for a rotary motor of great power and speed and of very small external diameter. For bent tubes the motor must also be very short to get around the bends. Nothing but the simplest device can reasonably be expected to long withstand the severe hammering to which a boiler-tube cleaning motor is subjected in use. The motor must be surely self-starting while in the tube, must be incapable of injury from overspeed or overload, and it can expect but little skilled care or attention. The motor

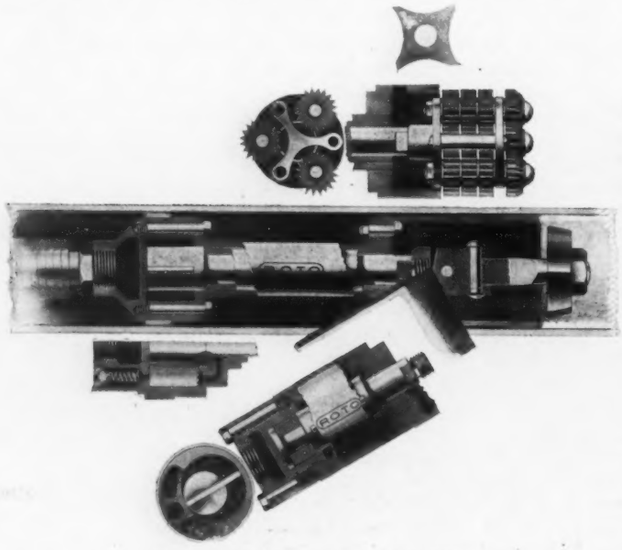


FIG. 2.—DETAILS OF TUBE CLEANER.

illustrated herewith is driven by either compressed air or steam and its general construction is evident from the illustrations. In the larger sizes and for straight tubes the single-bearing construction is used, while for smaller sizes and for bent tubes the piston is supported at both ends. The motor consists of only three essential parts, a rotary slotted piston, a sliding blade carried thereby and a cylinder. The single blade balances itself in centrifugal action and no spring is required as would be needed if two or more blades were used in a circular bore. The result is sure and strong self-starting, low initial and running friction, high speeds, great power, cool running and minimum wear of blade and cylinder. The use of a single blade also gives a full width of support in the slot of the piston and allows much greater eccentricity, displacement and power of the motor than would be possible with divided blades. The cylinder is not circular in bore, but of a form such that the round-edged blade will exactly fit across it in all positions of

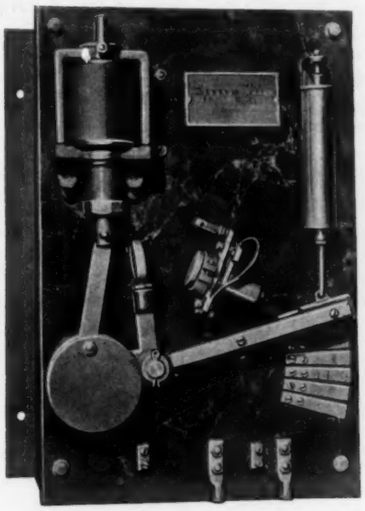
FIG. 3.—PISTON AND BLADES.

the slotted piston during its revolution. The success of the motor has been largely due to the successful designing and construction of automatic machinery for forming this cylinder bore to its peculiar curve, thus enabling a single blade to be used and allowing the motor to be simplified to the absolute limit of a positive-action flued pressure engine. The blade and piston are both of hardened steel and ground to size. The features of most general interest in the motor are its simplicity, large power per size and weight, high speed and great speed variation possible, its small initial friction, the low air or steam pressure on which it will operate, easy reversibility by a simple three-way cock and its very small inertia. The motor reverses as rapidly as the reversing cock can be operated. In the smaller sizes the motor operates with a no-load speed of more than 10,000 r.p.m. As a tube cleaner the power of the motor is said greatly to exceed that of the same diameter of water-driven turbine, so that only a small part of the available space is used for the cylinder, and the motor is armored with hardened steel rings to protect the cylinder from the hammering resulting from the greatly increased power, speed and work. As equipped for tube cleaning, several novel devices have been adopted to keep the cleaner at work on the scale and moving forward as rapidly as the scale is removed. The motor is manufactured by the Roto Company, of Hartford, Conn.

Auto-Starter for Motors.

The Automatic Switch Company, of New York City, has brought out another auto-starter for motors which combines many features of interest. The device is shown herewith. The starting solenoid shown at the upper left-hand corner fulfills the double purpose of closing the main line circuit and releasing by a gravity-actuated mechanism the resistor arm whose speed is governed by the consistency of the oil in the dash-pot. This is made possible owing to the peculiar construction of the solenoid. Usually magnets of the size shown with a long stroke have a weak pull at the start, which pull is rapidly increased until at the end of the stroke it reaches a maximum and strikes with a hammer blow. To get a strong pull at the start without the hammer effect at the end of the stroke, the company employs a hollow core with an adjustable rod having a slightly smaller diameter than that of the bore of the core. When the core is in its lowest position, the rod is not more than ½ in. away from the core and as the core is pulled up the rod tends to lag behind with a dash-pot effect and thus to prevent the core from striking the upper part of the frame hard enough to be objectionable. When the magnetic influence at the upper end is greatest the core comes to within ⅛ in. of the end of its stroke and presses the copper contact button on the flexibly-supported carbon contact, causing the latter in turn to press a button against a support and open a contact bridging a high resistance unit in series with the magnet. By this means the current is reduced to a fraction of its former value and considerably lower than the safe carrying capacity of the coil. It is essential that the speed of the core should be as great as

possible, since otherwise the arm would fall and bridge some of the starting resistors before the line switch was closed. By means of three cotter pins the moving mechanism can be re-

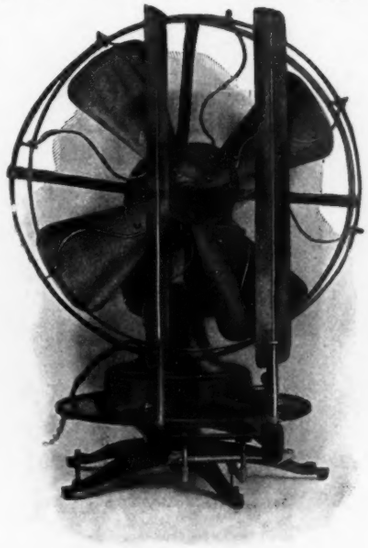


AUTO-STARTER FOR MOTORS.

moved for inspection and repair. Sand-packed resistor units are used in connection with the starter and the whole is mounted on a sheet-steel frame.

Oscillator for Electric Desk Fans.

The accompanying illustration shows the application of an oscillating device brought out by the Simplex Manufacturing Company, of New York, for electric fans. The device consists of a little table set on ball bearings on which a stationary desk fan is clamped, as shown. Attached to the table are two vanes against which the wind from the moving fan blades impinges. The vanes being set at an angle, the table turns until a lever attached to the paralleling mechanism to which the vanes are fastened strikes a stop on one of the feet of the base. This serves to set the vanes in an opposite angle, which in turn causes the table to revolve in the reverse direction also until the lever hits another stop when the direction is again changed. The dis-



OSCILLATOR FOR FANS.

tance through which the table swings may be adjusted by placing the stops nearer or farther apart, and if it is desired to have the breeze blow in one direction, the table may be adjusted for that purpose. The oscillator is purely mechanical in its operation and any type of desk fan can be used with it.

Automatic Time Switches.

The particular forms of automatic time switches shown in the accompanying illustrations have been developed for severe duties. Fig. 1 illustrates a device for controlling two separate

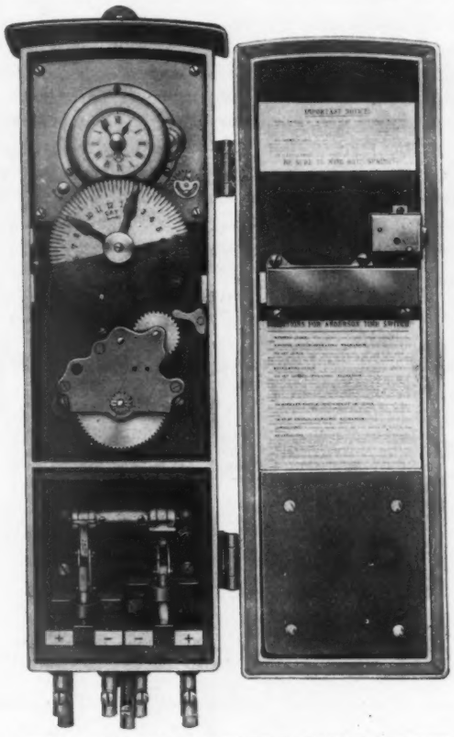


FIG. 1.—DOUBLE-POLE DOUBLE-BRANCH SWITCH.

circuits at intervals—that is, to close one circuit earlier than another, and open both at the same time, or one circuit before the other, and close both at the same time. This switch is

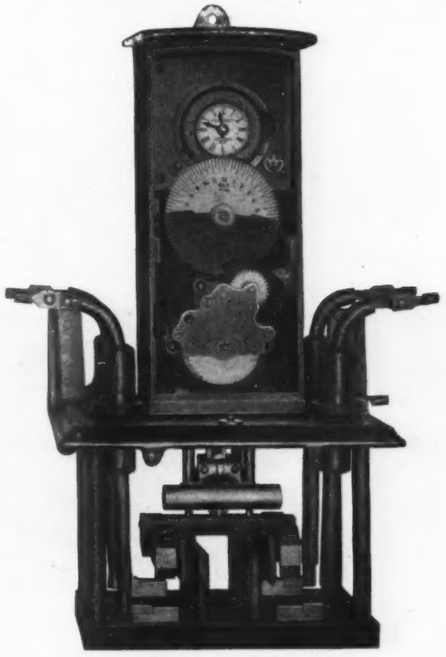


FIG. 2.—DOUBLE-POLE OIL SWITCH.

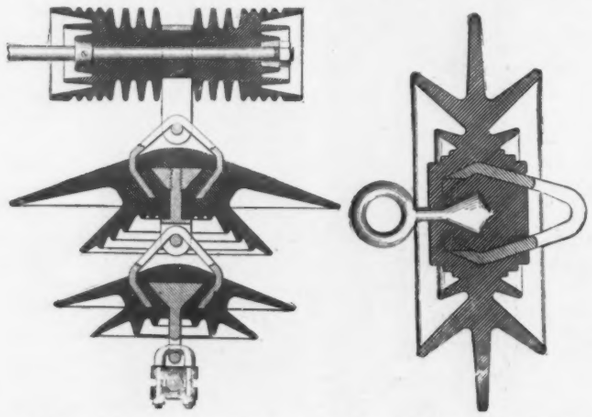
built for e.m.fs. not exceeding 250 volts and for currents from 25 to 200 amp.

The switch shown in Fig. 2 is constructed for e.m.fs. not exceeding 3000 volts. It is of the oil-break type, controlled by the standard clock and propelling mechanism. It is built

either double-pole or triple-pole for 25 or 50 amp. These switches have been placed on the market by Albert & J. M. Anderson Manufacturing Company, 289 A Street, Boston, Mass.

New Types of High-Tension Insulators.

The accompanying illustrations show three types of high-tension insulators for which patents have been issued to Mr. Louis Sternberger, and which are claimed practically to cover the entire field of application of insulators to the transmission of electric power up to the highest voltage that now appears will be reached in the future. In the design of the flexible suspension type shown, provision is made not only for insulating the conductor, but also for insulating the cross-arm or support,



FIGS. 1 AND 2.—SUSPENSION AND DISK STRAIN INSULATORS.

which in effect insulates the insulator. Owing to the flexibility of this structure all direct strain on the insulating material is avoided. The dead weight of the conductor, including snow or sleet and the effect of wind-pressure, is supported by insulating material which is wholly under compression. The form of the metal suspension members makes it quite impossible for the line to drop, even though the insulating material were totally destroyed.

The disk type of strain insulator shown provides large interrupted insulating surfaces for limiting surface leakage, while the design prevents moisture, soot or dust from forming a continuous conducting path extending from one strain member to the other over the surface of the insulator. The form of

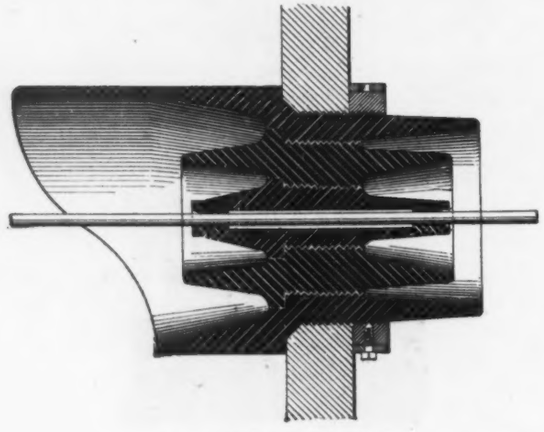


FIG. 3.—WALL INSULATOR.

the strain members and their relation to each other and to the insulating disk are such as to provide an insulator of exceptionally great mechanical strength combined with the highest form of electrical insulation. This disk type of strain insulator may be used separately, or a number of them may be linked together for supporting a line or used in any other desired relation where currents of very high potential are employed.

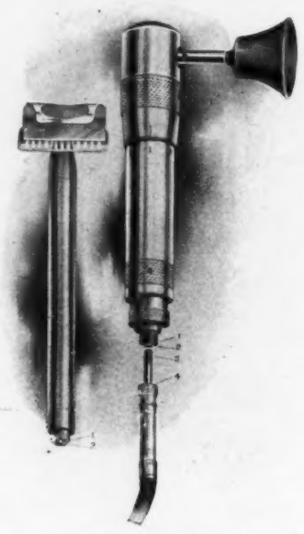
In the wall or barrier insulator shown, the several sections of which the bushing may be composed are separable; should either of the parts become injured or destroyed, it may readily be removed and a new section put in place, thereby avoiding the loss of the entire bushing. It will, of course, be evident that either one of the several bushings may be made of any predetermined length. The bushing is provided with a "protector" which shields the exposed parts from rain, snow, sleet, etc., and which may be made integral with the bushing or attached separately thereto. The central bushing is provided with detachable members for supporting the line centrally with relation to the bushing. By means of these members the central bushing may be made watertight, thereby maintaining at all times a dry surface within the bushing. Finally, an insulating locking member is provided for securing the bushing relatively to the wall or barrier, thereby obviating the trouble and expense incident to cementing a bushing into place or removing it. These bushings may be mounted into or removed from the wall very readily.

The insulators described are now being manufactured by the Electrose Manufacturing Company, Brooklyn, N. Y.

Electric Razor.

An electrical razor is one of the latest devices placed on the market by the Shelton Electric Company, Chicago, Ill. This razor is similar in design to the well-known safety razors so widely used throughout the United States. It consists of a handle, a blade and a blade holder. The handle is attached to the blade holder by a screw thread and the blades are held in the holder by a spring. The razor is designed to be used in connection with the company's "Twentieth Century Vibrator" and attaches directly to the spiral shaft of the vibrator. Inside of the handle of the razor is located a rotary eccentric which gives the blade a vibratory movement, this movement being sufficient to cut the hair as the blade of the razor is drawn down across the beard. The blade is protected by a safety device which makes it impossible to cut the flesh.

The blade of this razor is 1½ in. long and ¾ in. wide. The handle is about 5 in. long and the razor weighs complete 3½ oz. The device, being finished in nickel, has an attractive exterior appearance. The razor can be operated at variable speeds; and the faster the vibrator is operated the closer to the face the beard is cut. The company claims that for an ordinary, medium, shave it is necessary to draw the blade but once over the face.



ELECTRIC RAZOR.

Electrically Driven Saw-Mill.

The Central Pennsylvania Lumber Company has erected at Sheffield, Pa., a new lumber mill for sawing rough boards, as well as finished lumber, in which, as is the case with nearly all new mills, electric power is employed for driving the entire equipment. Wherever possible the machines are direct-connected to their driving motors. Three-phase, 60-cycle, 400-volt

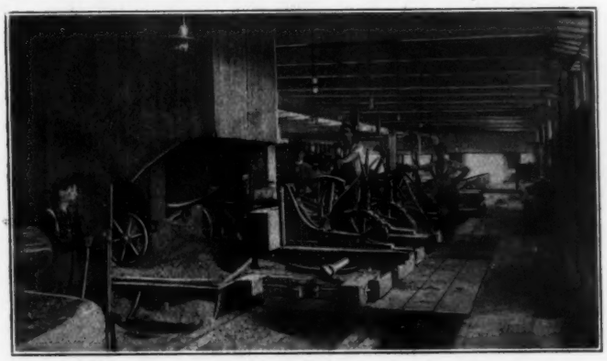


FIG. 1.—BAND MILL AND CARRIAGE, DRIVEN BY 150-HP BELTED MOTOR.

alternating current was determined upon as being the most satisfactory under all the conditions of service, and a complete power equipment, including boilers, engines, generator, motors and all the necessary measuring instruments and controlling devices, has been installed and arrangements made to burn the refuse from the mill under the boilers.

The logs are conveyed up the incline from the pond to the mill by a "log chain" or "log jacker," driven by a 15-hp back-geared motor running at 840 r.p.m. The chain is 190 ft. in length and carries 33 steel dogs for gripping the logs. The logs are first sawed into lumber by 8-ft. band mills, each of which is operated by a 150-hp motor running at 580 r.p.m. From both the band mills the sawed lumber is carried by line rolls

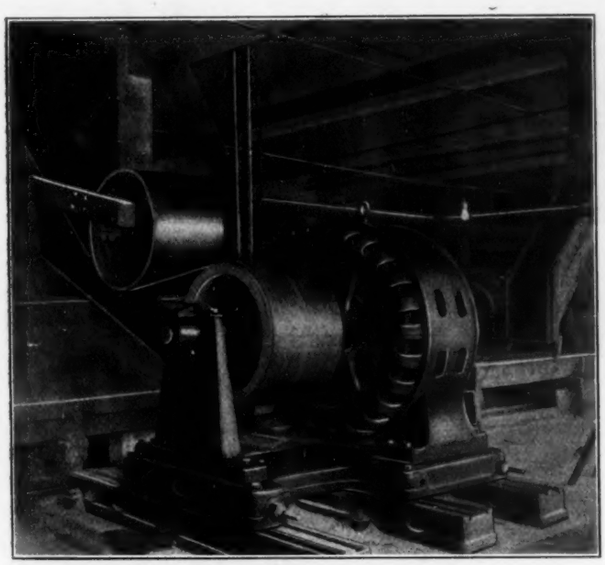


FIG. 2.—150-HP MOTOR DRIVING 8-FT. RE-SAW.

and transfers to a re-saw mill. Each set of 17 10-in. x 24-in. rolls is operated by a 7½-hp, 1120-r.p.m. motor through a back-gear on the motor. The re-saw is driven by a 150-hp motor, 580 r.p.m., connected by belt to the lower band-wheel shaft and gives to the saw a peripheral speed of about 9750 ft. per minute.

From the re-saw the 1-in. and 2-in. material is carried by conveyors to the two gang edgers, each of which has eight saws 24 in. in diameter, operated by a 50-hp, 1700-r.p.m. motor direct-connected to the shaft of the edger. After the lumber has passed through the edgers it is carried by line rolls to the trimmers, one of which has eight saws and the other 10. Each set is operated by a 30-hp motor running at 840 r.p.m. The motor also operates a pintle chain for conveying the lumber away. The lumber after being trimmed is conveyed on a chain through the assorting shed, where it is loaded onto cars by manual labor. The chain travels at the rate of 32 ft. per minute, being driven by a 15-hp, back-geared motor running at 1120 r.p.m.

From the band mills and the edgers the slabs are carried to slasher saws, which are saws mounted on a shaft 4 ft. apart. The slasher is operated from a 30-hp, 840-r.p.m. motor, which also operates six conveyor chains, each 100 ft. in length. A hog, for cutting the refuse into chips, is driven by a 75-hp motor, 690 r.p.m., direct-connected. It has a large rotating element weighing approximately 2000 lb., which carries 24 knives on a diameter of 60 in. Owing to the weight of the moving element of the hog, the starting conditions are particularly severe, but the motor, which is of the slip-ring type, brings the machine up to speed quickly without undue overload. The main refuse conveyor for carrying refuse to the boiler room is operated by a 10-hp, 1120-r.p.m. motor.

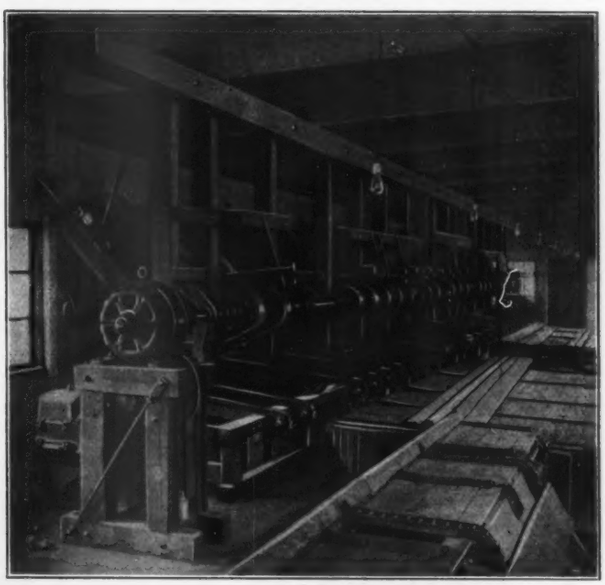


FIG. 3.—30-HP MOTOR DRIVING TRIMMERS.

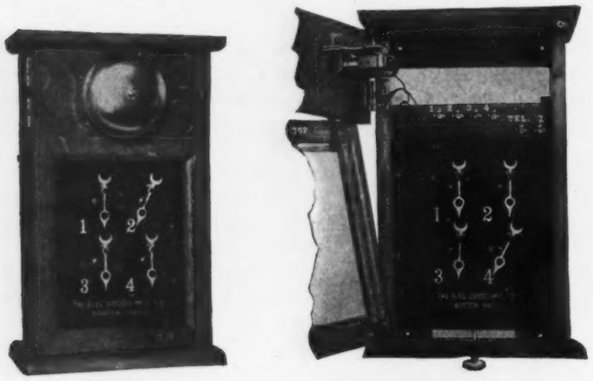
The woodworking equipment was supplied very largely by Clarge Brothers, and the motor equipment by the Westinghouse Electric & Manufacturing Company. The entire equipment represents a very good indication of what can be done by the individual application of electric motors to woodworking machines.

New Type of Annunciator.

An improvement in the well-known magnetized-needle form of annunciator now being placed on the market is shown in the accompanying illustration. In the old type of instrument false indications not infrequently resulted through the needles coming within the influence of the magnet cores while vibrating after being reset. In the new type the needles are attached to the face plate instead of to the set-back rod. A V-shaped slot in the set-back bar engages a lug on the needle which passes through the plate, thus returning the needle to its normal vertical position. No resetting oscillation is possible, as the slot brings the needle to immediate rest. Another feature of the new annunciator is that raising the set-back rod does not impart to the needles any general movement. In early types

where resetting "jiggles" all the needles, a strong magnet core often would reattract a needle, causing false indication.

The bell mechanism is attached to a frame hinged to the case. This allows the testing of the bell or lines to be done



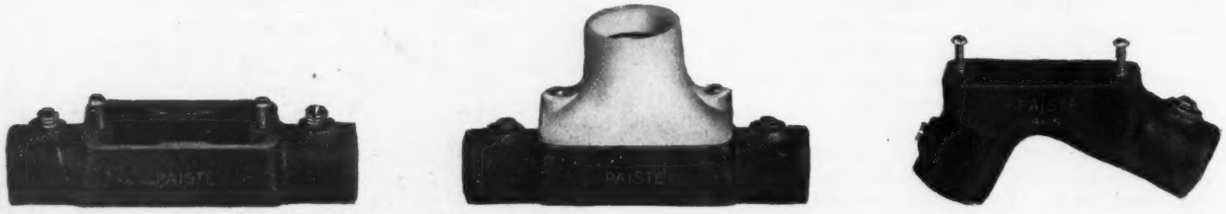
FIGS. 1 AND 2.—VIEWS OF ANNUNCIATOR.

without the removal of the bell from the case. The case is plain, with round corners; the terminals have lugs to prevent the wire slipping and are soldered to the wires from the magnet coils. A telephone terminal is added to one form, which enables telephones to be connected to the system, which is accomplished with no more wiring than that used for the ordinary annunciator. If the building has been wired, a telephone can be substituted for the push button at any outlet and a telephone for the attendants' use placed in the same room with the annunciator. The annunciator is also made with the operator's set attached to the case. This new type has been named the "Hub" and is made by the Electric Goods Manufacturing Company, Boston, Mass.

Conduit Fittings.

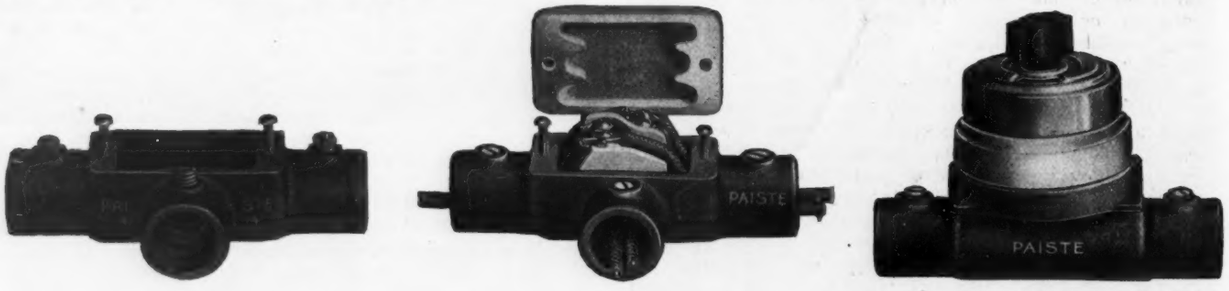
The H. T. Paiste Company, of Philadelphia, Pa., has brought out a line of conduit fittings which provide numerous possible combinations with the least number of parts. The fittings are uniform not only with respect to all covers, etc., but with all styles of Fielding molding receptacles and rosettes used so extensively in molding work. The conduit fittings have an opening of such size and shape that all standard Fielding receptacles can be used in conjunction with them. The opening is the same in shape and size for ½-in., ¾-in. and 1-in. conduit, so that the receptacles fit every type of fittings, and a one-hole cover, for instance, that fits the ½-in. size fits all others up to 1 in. Fig. 1 shows a straight fitting for ½-in. conduit, and Fig. 2 shows the fitting with a receptacle applied. The fitting is attached to the conduit by pipe threads located inside the sleeve and by means of a set-screw adjustment the work may be lined up with exactness. Five types of fittings have been on the market; the straight-through fitting, the end fitting, side-drop fitting, end-drop fitting and the branch fitting. To these have been added an elbow fitting and a snap-switch fitting. The former can be used for making a short right-angle turn and also a pull outlet. The opening is placed on the outside of the bend, as shown in Fig. 3, and all inside lines are easy curves with smooth surfaces. The design is such that the wires can be pulled straight through and then fed through the other arm without any abrasion or other injury. The elbows are galvanized inside and out and are furnished with soft rubber gaskets and plain steel covers.

The receptacles are wired just as in molding work; the button part rests on the two inward projecting lugs in the opening of the fitting, and the wires loop up and set under the receptacle set screws. The cover is fastened with two brass screws, provided with each fitting. In the design of the many special fittings for the "pipe taplets," as they are called by the manufacturer, many labor-saving improvements have been embodied. In the branch fitting, for instance, shown in Figs. 4 and 5, a branch line may be connected without soldering and taping. The button part rests over the opening of the pipe fitting, the mains are looped up over it and the wires bared to set under set screws. The branch wires are connected to the other set screws, as shown in Fig. 5, and the cover screwed in place. If instead of a branch, an outlet for two-wire molding is desired, a cover with the necessary holes is provided, the wiring connections being made as in the case of a branch connection. For standard types of snap switches an additional fitting for all types of pipe taplets is employed, as shown in Fig. 6. The switch fitting is first attached with long brass screws, the loose yoke fitting which forms part of the device being taken out and fastened loosely to the switch. The latter is then placed on the fitting so that this loosely hanging yoke piece slips through rectangular recesses and the whole is turned so that the handle of the switch is square with the fitting. Then, by tightening the screws which hold the switch to the yoke, the whole is securely fastened. The 5-amp fitting is similar to the 10-amp fitting, except that it has a smaller opening to accommodate the smaller base of that size switch.



FIGS. 1 AND 2.—STRAIGHT CONDUIT FITTING, WITHOUT AND WITH RECEPTACLE.

FIG. 3.—ELBOW FITTING.



FIGS. 4 AND 5.—BRANCH CONDUIT FITTING, WITHOUT AND WITH WIRING.

FIG. 6.—SNAP SWITCH FITTING.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

The end of the holiday season brings encouraging reports of the business that has been done. Taking the country as a whole, the holiday trade has been better than in 1907, and, in fact, the volume of business in money is about equal to 1906. In the metal industries business is quiet, as is always the case at this season of the year. Only small orders for pig iron have been placed; no considerable order for steel rails has been reported since the Pennsylvania contract was made and structural material is being ordered in very light tonnages. In the wholesale and jobbing business there is the same quiet that always prevails at the end of the year. In fact, no orders are being received except for odd lots to fill up broken stocks. Inventories are being taken and the decks are being cleared for next year's business. As to this latter, there is a very general agreement that the coming year would be better to a large extent than the past one. Reports from collections are fair and there appears to be little disposition on the part of buyers to go in more extensively than they can readily afford. Business failures for the five days ending Dec. 23 were 196, against 311 the week previous, 248 in the like week of 1907, 161 in 1906, 212 in 1905, 218 in 1904.

THE COPPER MARKET.

The copper market is a trifle firmer than it was a week ago and while the bid price is no higher the holders are more rigid in their demands. This better tone is due entirely to the renewed activity of the speculative interests both in this country and in Europe which have been covering contract sales made abroad by purchases in this market. While it seems evident that a few smelters are growing nervous over the persistent steadiness with which prices are held, there has not been sufficient interest displayed by consumers to cause any upward movement. It is known that the commitments of European speculators are still large, and this knowledge of itself has a hardening tendency. Just before the holidays there were a few sales made in this market at 14⅜c. for January, February and March delivery but the average price was lower. At present quotations consumers show no anxiety to contract extensively for future deliveries. Buying for immediate needs is about the only buying that appears. In the meantime statistics continue to indicate steady accummulation. While exports for December will be larger than for many months, they do not when added to the consumption account for all of the copper that has come into sight. At the present time the production of the mines in this country is about 90,000,000 lb. per month and the imports have been recently about 20,000,000 lb. To offset this there have been exports averaging less than $50,000,000 lb. and a domestic consumption of less than 45,000,000 lb. The conclusion that there is an accumulation is therefore unavoidable, although it is persistently denied by selling agencies and producers. One authority has published estimates of the surplus stocks of copper at the end of the year as 225,000,000 lb. in Europe and 210,000,000 lb. in this country. This would indicate an accumulation during the year in the United States of 75,000,000 lb. as the government figures placed the surplus Jan. 1, 1908, at 135,000,000 lb. That these figures are so largely estimates and arrived at by inference is one of the serious handicaps of the copper market. The leading producers and dealers recognize this deficiency of exact information as was made evident recently when all the principal interests represented in New York met in conference at the office of Phelps, Dodge & Company. It was given out at the time that the sole purpose of the meeting was to make arrangements for the collection and tabulation of statistics on copper production and consumption. At this meeting a committee was appointed to formulate plans for systematizing the statistics of the copper industry. It was reported, and largely believed, in the market that the meeting was for the purpose of forming a "gentleman's agreement" among producers to maintain copper prices in the same way that steel prices are maintained. This was vigorously denied by the leading participants in the meeting, but the market continues to grow firmer. It might also be remarked that copper stocks have advanced several points within the past 10 days and good buying has developed. The exports from this country for December up to and including Dec. 28 have been 20,955 tons. Prices quoted on the Metal Exchange on that date were:

Lake	14¼	@	14½
Electrolytic	14	@	14¼
Castings	13⅞	@	14⅛

Following are the London quotations:

	Noon. £	s	d	Close. £	s	d
Standard copper, spot	63	12	6	63	7	6
Standard copper, futures	64	10	0	64	5	0
Market	Firm.			Easy.		
Sales of spot	150 tons					
Sales of futures	700 tons					

Extreme fluctuations for 1908:

	Highest.			Lowest.		
Lake copper, spot	14½			12⅜		
Electrolytic copper, spot	14⅜			12¼		
Casting copper, spot	14¼			12⅛		
London, spot	£64	17	6	£56	5	0
London, futures	65	15	0	56	17	0
London, best selected	68	10	0	50	0	0

THIRD AVENUE CONTRACTS.—The Third Avenue Railroad Company, of New York City, through Frederick W. Whitridge, receiver, has awarded the Westinghouse Electric & Manufacturing Company—as foreshadowed in the ELECTRICAL WORLD of Dec. 19, 1908—the contract for equipping the new substation at Webster and Brook Avenues, in the Bronx. The installation will include four 1500-kw rotary converters and 12 550-kw air-blast transformers. The railroad company wants the equipment delivered as rapidly as it can be prepared. In addition to this the Westinghouse Electric & Manufacturing Company was successful in securing the contract for 200 motor equipments for the 200 new cars which the company is ordering at this time. The equipments will be the Westinghouse No. 310 motor, which is of a special interpole, box type designed and made expressly for the Metropolitan Street Railway, which has equipped 127 new cars with them. The motor equipments are expected to be delivered in June.

WESTERN ELECTRIC COMPANY'S BUSINESS.—The gross sales of the Western Electric Company for the year which ended Nov. 30—the date on which its fiscal year ends—are estimated to be about $30,000,000. During the year the quantity of stock carried has been considerably reduced and many economies in operation have been practised. Labor conditions have shown but slight changes during the year, the average of wages having neither advanced nor declined. At the present time the company has on its pay rolls about 13,000, which is 3000 less than were employed a year ago. Sales during the year have been largely restricted to the smaller types of apparatus. The new switchboard for the Paris telephone exchange was one of the largest orders handled.

LARGE CONTRACT FOR BLOCK SIGNALS.—The Union Switch & Signal Company has been awarded a contract for 500 miles of automatic block signaling on the Chicago, Rock Island & Pacific Railroad. A short time ago the company was given a contract for 750 miles of automatic block signaling on the St. Louis & San Francisco, which road is a part of the Rock Island system. Therefore, the two orders are essentially one, and together they make the biggest automatic block signaling contract ever placed at one time except the contracts for the signaling of the Harriman lines, which the company received two years ago. It is expected that all of this work will be completed within 12 months or 15 months.

AMERICAN DIESEL ENGINE COMPANY.—The United States Court of New York has appointed John L. Wilkie receiver of the American Diesel Engine Company, with offices at 11 Broadway, New York, and factory at Providence, R. I. The company has been manufacturing oil and gas engines, and the receivership was brought about by an acknowledgment of its inability to meet its obligations. Adolphus Busch, of St. Louis, who was formerly president of the company, is a creditor to the extent of $200,000 for money loaned on notes.

BRUCE PEEBLES REORGANIZATION.—Advices from Edinburgh, Scotland, state that Bruce Peebles & Co., Ltd., of that city, have been reorganized. The business has been conducted without any interruption, and its control is now in the hands of an entirely new and influential board of directors. The new board consists of the following gentlemen: Messrs. A. W. Tait, W. B. Mountain, C. J. Shiells, Alex. Mackenzie, C. H. M'Euen and F. E. Andrews. The secretary of the company is John M. Peebles.

REPORTS OF LARGE ELECTRICAL COMPANIES ENCOURAGING.—Reports from the largest manufacturing concerns in the electrical apparatus field are extremely encouraging. Officials of the General Electric Company announced that there has been a very substantial increase in orders recently, and that the outlook for the future is satisfactory. Additional hands are being taken on each week at the corporation's various plants. The company's lamp works at Harrison, N. J., are being operated at full capacity. The Schenectady shops are being run at about 70 per cent of capacity, and the West Lynn (Mass.) works are employing 7000 workmen. The first half of December, it is reported, showed a gain of 4 per cent over November, and the great number of inquiries that are being received promise a heavy business early in 1909. The Westinghouse Electric & Manufacturing Company reports a steady increase of business. More employees are being put to work every week, and it is anticipated that by the end of January the shops will all be running at normal capacity. Posters have just been placed in the Westinghouse Air Brake Company's plant, at Wilmerding, Pa., announcing that with the beginning of the new year the men will resume work at full time. The notices apply to the employees of both the shops and the foundry, where some of the men have been working short turns. The Allis-Chalmers Company states that orders are coming in in good volume and that inquiries lead the management to expect a heavy increase in business. A good many orders are being placed for municipal water and power plants, although the bulk of the company's new business is for mining machinery. All of the plants of the company are in operation, although not at full capacity. The Western Electric Company is operating at 80 per cent of normal capacity, and is booking many orders for small apparatus.

Financial Intelligence.

THE WEEK IN WALL STREET.

The holiday week was almost entirely one of advance. After a reaction that lasted several days and which continued for the first day of the week under review the market took a turn and continued upward without interruption. This recovery was not accompanied by any particular large business, but there were sufficient willing purchasers to make the sustaining of prices an easy matter. It is pretty generally conceded that the weakness in steel stock and in those kindred issues which are held by the same interests was attributable to Mr. Carnegie's testimony before the Ways and Means Committee of Congress. One of the most encouraging features of the business during the short week was the unabated demand on the part of investors for good bonds. On one day, Dec. 22, there were sold on the Stock Exchange, $10,800,000 worth of bonds. This was the largest single day's transactions in bonds since 1904. The $11,000,000 Chesapeake & Ohio 5 per cent issue was so largely oversubscribed that the books had to be closed within a very few minutes after their opening. When the Boston & Maine made offers covering a similar amount the subscriptions reached $35,000,000. It is now said that there will be a new issue of $15,000,000 by an industrial company within the next two weeks, and the greedy bond grabbers are industriously endeavoring to get advance information as to what this issue will represent. The money market during the week has been just about as cheap as heretofore, but loans have been somewhat contracted. This has been shown in the bank statement, and is in a measure responsible for the limiting of transactions upon the Stock Exchange. The banks have called their loans not because there was any particular scarcity of cash but because the demands from abroad and the necessities of meeting the dividends at the end of the year have created a conservative sentiment. On Dec. 28 call money was quoted at 2¾ @ 3½ and 90-day loans at 3½ @ 3¾. The quotations in the table are those of the close Dec. 28.

NEW YORK.

	Dec. 21.	Dec. 28.	Shares Sold.		Dec. 21.	Dec. 28.	Shares Sold.
All.-Ch.	15¼	16	1,600	Int.-Met., pfd...	43⅞	47⅞	72,410
All.-Ch., pfd....	48⅝	50	2,375	Mackay Cos....	74	75*	700
Amal. Cop.	77⅞	84½	173,675	Mackay Cos., pfd.	69	70	300
Am. D. T.....	35*	35*	——	Manhattan Elev.	150¼	154½	7,120
Am. Loc.	54¼	58¼	16,195	Met. St. Ry....	35	42½	1,500
Am. Loc., pfd..	109½	111	470	N.Y. & N.J.Tel.	112*	112*	——
Am. Tel. & Cbl.	78*	78*	——	Steel, com.....	52⅛	54¾	409,264
Am. T. & T....	127	129	6,800	Steel, pfd.....	111⅛	112¾	15,254
B. R. T.....	59¼	68	236,650	W. U. T.....	65¾	68⅜	2,710
Gen. Elec.....	156¾	160½	3,400	West'h., com....	84½	85½	5,200
Int.-Met., com..	18½	19	94,022	West'h., pfd....	120*	120*	——

PHILADELPHIA.

	Dec. 21.	Dec. 28.	Shares Sold.		Dec. 21.	Dec. 28.	Shares Sold.
Am. Rys.	46*	45¾*	——	Phila. Elec. ...	11	11¾	——
Elec. Co. of A..	11	11	——	Phila. R. T....	21⅜	23⅛	——
Elec. Stor. B'ty.	44¼	46½	——	Phila. Traction..	90	90½	——
E. S. B'ty, pfd..	49*	49*	——	Union Traction..	49	50⅜	——

CHICAGO.

	Dec. 21.	Dec. 28.	Shares Sold.		Dec. 21.	Dec. 28.	Shares Sold.
Chi. City Ry....	180*	180*	——	Chi. Tel. Co....	129	127½	——
Chi. Rys., Ser. 1.	118*	116	——	Met. El., com...	18	18*	——
Chi. Rys., Ser. 2.	45	45½	——	Nat'nal Carbon.	86*	85	——
Com. Edison...	105¾	107	——	Nat. Carb., pfd.	112*	112*	——
Chi. Subway...	26	30⅜	——				

BOSTON.

	Dec. 21.	Dec. 28.	Shares Sold.		Dec. 21.	Dec. 28.	Shares Sold.
Am. Tel. & Tel..	127⅜	129½	——	Mass. E. R., pfd.	57¼*	58	——
Cum. Tel.	125⅞	125⅞	——	Mex. Tel.	2¼*	2½	——
Edison El. Ill...	241	241	——	Mex. Tel., pfd.	5½*	5½*	——
Gen. Elec.....	156	160½	——	N. E. Tel.....	126	126¾	——
Mass. Elec. Ry.	12	12⅛	——	W. Tel. & Tel..	7¾*	7¾*	——
				W. T. & T., pfd.	78½*	78½*	——

*Last price quoted.
Shares sold are for week Dec. 21 to Dec. 24.

DIVIDENDS.

American Car & Foundry Company, New York, N. Y., quarterly, preferred 1¾ per cent, payable Jan. 1.

American Car & Foundry Company, New York, N. Y., quarterly, common, ½ per cent, payable Jan. 1.

American Locomotive Company, New York, N. Y., quarterly, preferred, 1¾ per cent, payable Jan. 21.

Bell Telephone Company, St. Louis, Mo., quarterly, common, 2 per cent, payable Jan. 20.

Central & South American Telegraph Company, New York, N. Y., quarterly, preferred, 1½ per cent, payable Jan. 8.

Garvin Machine Company, New York, N. Y., semi-annual, preferred, 3½ per cent, payable Jan. 1.

Mexican Telegraph Company, New York, N. Y., quarterly, preferred, 2½ per cent, payable Jan. 15.

Michigan Light Company, Kalamazoo, Mich., quarterly, preferred, 1½ per cent, payable Jan. 2.

Michigan Light Company, Kalamazoo, Mich., quarterly, common, 1 per cent, payable Jan. 2.

New England Telephone & Telegraph Company, Boston, Mass., quarterly, common, 1½ per cent, payable Jan. 15.

New York & New Jersey Telephone Company, New York, N. Y., quarterly, common, 1¾ per cent, payable Jan. 15.

North America Telegraph Company, Minneapolis, Minn., annual, common, 6 per cent.

Pennsylvania Company, Philadelphia, Pa., semi-annual, preferred, 4 per cent, payable Dec. 31.

Toronto Railway Company, Toronto, Ont., quarterly, preferred, 1½ per cent, payable Jan. 2.

United Gas Improvement Company, Philadelphia, Pa., quarterly, preferred, 2 per cent, payable Jan. 15.

United State Telephone Company, Cleveland, Ohio, quarterly, preferred, 1½ per cent, payable Feb. 15.

United Traction & Electric Company of New Jersey, quarterly, preferred, 1¼ per cent, payable Jan. 20.

NORTHERN CALIFORNIA POWER COMPANY, CONSOLIDATED.—The directors of the Northern California Power Company, Consolidated, at a meeting in Chicago, declared a dividend of 10 cents per share, payable Dec. 22 by check. This is the first monthly dividend since the reorganization of the Northern California Power Company and is at the rate of 6 per cent per year. The Northern California Power Company paid regular dividends of 5 cents per share until October, 1907. The Northern California Power Company, Consolidated, has recently closed important contracts for additional power from its plant. Its original contract to supply 5,000 hp to the California Gas & Electric Company was changed and increased on Dec. 4 to 10,000 hp. The company will deliver 5,000 hp in January and will probably be in a position to deliver 10,000 hp by July, 1909.

AMERICAN TELEPHONE & TELEGRAPH COMPANY.—The report of all the associated Bell telephone operating companies (not including the long-distance lines) of the American Telephone & Telegraph Company for the 10 months ended Oct. 31, 1908, was issued on Dec. 16. It shows as follows:

Jan. 1 to Oct. 31.	1908.
Telephone revenue	$99,168,600
Expenses for operation and maintenance	72,515,400
Balance from operation	$26,653,200
Sundry earnings (net)	4,296,600
Total net	$30,949,800
Interest	6,388,400
Balance for dividends	$24,561,400

The statement of earnings of the company for October follows.

October.	1908.
Telephone revenue	$10,261,800
Expenses for operation and maintenance	7,401,000
Net from operation	$2,860,800
Sundry earnings (net)	430,400
Total net	$3,291,200
Interest	621,400
Balance for dividends	$2,669,800

MASSACHUSETTS ELECTRIC COMPANIES.—At the annual meeting of the stockholders of the Massachusetts Electric Companies, Boston, on Dec. 16, Mr. Richard Olney, Mr. Charles E. Cotting, Mr. Eugene U. Foss, Mr. Percy Barker and Mr. Charles Francis Adams, Jr., were re-elected trustees for five years, and it was voted to authorize the trustees to sell 7236 shares of the preferred stock of the Boston & Northern Street Railway and 3726 shares of the preferred stock of the Old Colony Street Railway at $110 a share, as authorized by the Railroad Commission. President Abbott is quoted as having said: "It seems unwise to adopt any scheme for dealing with back dividends until the company is again fully restored to a 4 per cent preferred dividend basis. If earnings warranted, it was hoped to pay 2 per cent in July. However, the trustees were confident that dividends at some rate could be steadily maintained, and it was only after reaching this decision that they decided to authorize the 1 per cent declared."

VIRGINIA PASSENGER & POWER COMPANY.—The holders of the securities of the Virginia Passenger & Power Company, Richmond Passenger & Power Company, Richmond Traction Company and controlled properties have been notified by the committee representing the bondholders of the companies that as appeals have been taken from the decree of foreclosure and sale made by the Circuit Court of the United States for the Eastern District of Virginia it will not be possible to issue the proposed new securities on Jan. 1, 1909, and accordingly there can be no interest payments on that date. The Appellate Court has set down the appeal for argument on Jan. 13, 1909, and it is anticipated that the case will be reached early in February, which will make it possible to issue new bonds soon thereafter. At that time all past due coupons on the new bonds will be paid. More than 90 per cent of all the securities for which provision is made in the plan of reorganization have been deposited.

AMERICAN TELEPHONE & TELEGRAPH COMPANY.—A special meeting of the stockholders of the American Telephone & Telegraph Company, New York, has been called for Jan. 7 for the purpose of authorizing an increase in the capital stock of the company from $250,000,000 to $300,000,000. This new stock and the 69,413,000 of unissued stock of the company will be applied for conversion of the $150,000,000 of 4 per cent convertible bonds of the company into stock. In issuing the call for the meeting, President Vail said: "The bonds, by their terms, are convertible after March 1, 1909. The present issued capital stock of the company is $180,587,000. The authorized capital stock is $250,000,000. As the unissued capital stock, $69,413,000, is insufficient to meet the conversion of these bonds, if made, further stock amounting to more than $40,000,000 being required, a proposition will be submitted to stockholders to increase the capital stock of the company by the sum of $50,000,000."

ILLINOIS TUNNEL COMPANY.—President McRoberts, of the Illinois Tunnel Company, Chicago, is quoted as saying in regard to the claim of the city of Chicago that 20,000 telephones will be in service by February, 1909: "We can dispose of this plant to financially responsible telephone people, who will develop it. I consider it a bona fide offer, but we must have a clear title. It would take us at least two years to make this dead telephone property of ours pay. The city must decide whether it wants a second telephone system. We can give it, or we are willing to trade with the city in a proposition to do away with the telephone feature of our franchise."

DIVIDEND AND INTEREST DISBURSEMENTS.—It is estimated that the dividend and interest disbursements for January, 1909, will exceed $210,000,000. A recent statement gives the following total comparative disbursements:

	1909.	1908.	1907.
Dividend payments	$75,218,000	$76,936,000	$71,347,000
Interest payments	133,492,000	115,327,000	110,948,000
Totals	$208,710,000	$192,263,000	$182,295,000

About $800,000,000 of bonds and $300,000,000 of notes were issued during the year and account largely for the increase in interest disbursement in January, 1909, over the two preceding years.

MIAMI & ERIE CANAL TRANSPORTATION COMPANY.—A conference was held recently between the Cincinnati stockholders of the Miami & Erie Canal Transportation Company, Cincinnati, Ohio, and Mr. D. B. Spandaner and Mr. S. Spandaner, bankers of Baltimore, and, it is said, that an application will soon be made to the courts for the sale of the canal property and the discontinuance of the receivership. The company was organized to build an electric railway along the Miami & Erie Canal between Cincinnati and Dayton for passenger service and for hauling canal boats.

CONSOLIDATED RAILWAY, LIGHTING & REFRIGERATING COMPANY.—The assets of the Consolidated Railway, Lighting & Refrigerating Company, New York, have been sold for $2,008 to a reorganization committee consisting of Isaac L. Rice, formerly president of the company; A. G. Fromuth, formerly vice-president of the company, and J. L. Watson, formerly secretary and treasurer of the company. The reorganization plan includes the organization of a new company with $8,000,000 capital stock divided into 320,000 shares of a par value of $25 each.

MACON RAILWAY & LIGHT COMPANY.—Mr. W. J. Massee, president of the Macon Railway & Light Company, Macon, Ga., and his associates have purchased the holdings of common stock of the Happ estate and others, thus giving Mr. Massee and his associates control of the property. It is said, unofficially, that Mr. Massee will remain as president of the company and that negotiations are under way with the Central Georgia Power Company for a long term contract to supply power to the Macon Railway & Light Company.

BIRMINGHAM RAILWAY, LIGHT & POWER COMPANY.—Isidore Newman & Sons, New York and New Orleans; the Altheimer & Rawlings Investment Company, St. Louis, Mo., and the United States Trust Company, Louisville, offer at 103½ and interest the small unsold portion of a block of $1,000,000 "refunding and extension mortgage 6 per cent gold bonds" of the Birmingham Railway, Light & Power Company, Birmingham, Ala., dated May 1, 1907, and due May 1, 1937, without option of prior payment.

CHICAGO TELEPHONE COMPANY.—Lee, Higginson & Company, Boston, offer for subscription at 102 and interest $3,000,000 of 5 per cent first mortgage bonds of the Chicago Telephone Company. The bonds are dated Dec. 1, 1908, and are due on Dec. 1, 1923, but are subject to call at 105 and interest on or after Dec. 1, 1913, upon three months' notice.

UNITED ILLUMINATING COMPANY.—The stockholders of the United Illuminating Company, New Haven, Conn., will be offered the right to subscribe at par for $300,000 additional capital stock of the company, making the total stock issued $1,500,000. The subscriptions are to be payable in four equal installations between April 15, 1909, and Oct. 15, 1910.

NATIONAL GAS, ELECTRIC LIGHT & POWER COMPANY.—The National Gas, Electric Light & Power Company, Detroit, Mich., has sold to Bioren & Company and Townsend Whelen & Company, both of Philadelphia, $400,000,000 of new 6 per cent collateral trust notes to retire the $3,000,000 of 5 per cent notes maturing on Jan. 1.

EDISON ELECTRIC COMPANY OF LOS ANGELES.—The Edison Electric Company, Los Angeles, Cal., has called a meeting of the stockholders of the company for Feb. 27, 1909, to vote on a plan to issue $30,000,0000 of bonds.

LITTLE ROCK RAILWAY & ELECTRIC COMPANY.—The Little Rock Railway & Electric Company, Little Rock, Ark., has increased its annual dividends from 4 per cent to 5 per cent by the declaration of the semi-annual dividend of 2½ per cent on the $1,500,000 of common stock, payable Dec. 31.

ROCHESTER, CORNING & ELMIRA TRACTION COMPANY.—The Rochester, Corning & Elmira Traction Company, Rochester, N. Y., has filed with the Carnegie Trust Company, New York, as trustee, a mortgage to secure an issue of $1,000,000 of 5 per cent 30-year gold bonds.

REPORTS OF EARNINGS.

	Gross Earnings.	Expenses.	Net Earnings.	Charges.	Surplus.
American Telephone & Telegraph Company, New York, N. Y.:					
November, 1908	$2,090,845	$169,390	$1,921,455	$638,868	$1,282,587
November, 1907	1,950,268	164,694	1,785,574	681,578	1,103,996
Birmingham (Ala.) Railway, Light & Power Company:					
November, 1908	188,414	*128,699	59,715	44,468	15,246
November, 1907	202,141	*135,800	66,341	42,579	23,762
Brockton & Plymouth Street Railway, Plymouth, Mass.:					
October, 1908	9,767	6,216	3,551	2,151	1,400
October, 1907	9,057	6,716	2,341	2,250	91
Cape Breton Electric Company, Sydney, N. S.:					
October, 1908	22,166	12,750	9,416	4,955	4,460
October, 1907	22,878	12,889	9,989	4,852	5,137
Dallas (Tex.) Electric Company:					
October, 1908	134,140	73,767	60,373	27,554	32,819
October, 1907	125,771	72,291	53,481	28,481	25,000
Detroit (Mich.) United Railways:					
November, 1908	577,208	374,685	202,523	132,818	69,705
November, 1907	565,835	370,259	195,576	134,619	60,967
El Paso (Tex.) Electric Company:					
October, 1908	44,913	33,544	11,369	7,107	4,262
October, 1907	46,474	30,776	15,708	5,993	9,714
Electric Light & Power Company of Abington & Rockland, North Abington, Mass.:					
October, 1908	5,109	2,884	2,225	328	1,897
October, 1907	5,060	2,386	2,674	452	2,222
Galveston-Houston Electric Company, Galveston, Tex.:					
October, 1908	94,348	52,842	41,506	20,192	21,313
October, 1907	89,940	53,521	36,419	19,671	16,748
Houghton County Traction Company, Houghton, Mich.:					
October, 1908	21,654	10,941	10,712	5,380	5,333
October, 1907	20,652	12,765	7,887	4,823	3,074
Jacksonville (Fla.) Electric Company:					
October, 1908	38,509	21,144	17,365	8,145	9,220
October, 1907	33,697	20,332	13,365	7,149	6,216
Knoxville (Tenn.) Railway & Light Company:					
November, 1908	47,968	*22,859	25,110	11,483	13,626
November, 1907	50,713	*25,692	25,021	11,420	13,601
Little Rock (Ark.) Railway & Electric Company:					
November, 1908	59,091	*27,956	31,135	10,255	20,880
November, 1907	57,754	*28,977	28,777	8,653	20,124
Massachusetts Lighting Companies, Boston, Mass.:					
November, 1908	46,929	.....	.....	.....	.....
November, 1907	44,510	.....	.....	.....	.....
Memphis (Tenn.) Street Railway:					
November, 1908	136,376	*87,560	48,816	35,312	13,504
November, 1907	125,979	*85,324	40,655	34,435	6,219
Northern Texas Electric Company, Fort Worth, Tex.:					
October, 1908	119,299	56,103	63,195	15,187	48,008
October, 1907	114,460	58,164	56,295	13,886	42,409
Portland (Ore.) Railway, Light & Power Company:					
November, 1908	370,378	165,331	205,047	.....	.....
November, 1907	347,598	178,534	169,064	.....	.....
Puget Sound Electric Railway, Tacoma, Wash.:					
October, 1908	147,152	95,977	51,174	44,257	6,917
October, 1907	141,985	92,056	49,929	40,297	9,632
Savannah (Ga.) Electric Company:					
October, 1908	51,071	30,304	20,767	15,911	4,856
October, 1907	51,313	35,564	15,749	14,855	894
Seattle (Wash.) Electric Company:					
October, 1908	401,935	233,624	168,310	97,084	71,226
October, 1907	374,379	208,598	165,781	84,072	81,709
Tampa (Fla.) Electric Company:					
October, 1908	47,354	30,170	17,184	4,380	12,804
October, 1907	45,572	34,958	10,614	759	9,855
Twin City Rapid Transit Company, Minneapolis, Minn.:					
November, 1908	526,574	259,780	266,794	143,667	123,127
November, 1907	497,429	264,410	233,018	131,142	101,877
Whatcom County Railway & Light Company, Bellingham, Wash.:					
October, 1908	31,758	17,766	13,991	9,026	4,965
October, 1907	32,379	17,949	14,431	7,181	7,250

*Including taxes.

GENERAL NEWS

Construction News.

AUBURN, ALA.—The Council has granted a 30-year franchise for lighting the town of Auburn. Electricity for operating the system will be supplied from the electric plant of the Alabama Polytechnic Institute. C. C. Thach is president of the institute.

MONTGOMERY, ALA.—The People's Electric & Ice Company has taken over the properties and holdings of the Edison Electric Company and the Exchange Ice Works, together with the franchises under which they operate. The new company, it is said, proposes to increase the output of the plant. A. G. Forbes is president and C. E. White treasurer and general manager.

MARICOPA, ARIZ.—The Arizona Mercantile, Transportation & Smelter Company, which is said to operate mines in Arizona, has applied to the Mexican Government for a concession to build an electric railway through a narrow strip of this country in order to reach St. George's Bay, a proposed deep water harbor situated in the extreme upper end of the Gulf of Lower California. It is planned to make Maricopa, Ariz., the United States terminus of this line. The road will be about 160 miles long and will be used chiefly for freight.

PHOENIX, ARIZ.—The Clara Consolidated Gold & Copper Mining Company is making arrangements to install an electric plant in connection with its smelter.

WICKENBURG, ARIZ.—The citizens are considering the question of installing a municipal electric light plant.

HOLLY GROVE, ARK.—The question of installing an electric light plant in Holly Grove is under consideration. E. W. Burruss is interested in the project.

ARBUCKLE, CAL.—The question of installing an electric light plant in the town is under consideration. William H. Ash is interested in the project.

COLUSA, CAL.—The Board of Supervisors has granted a franchise to C. K. Sweet to erect transmission lines for the distribution of electricity.

DELANO, CAL.—The Mt. Whitney Power Company, of Visalia, Cal., has filed an acceptance of the electric light franchise in Delano.

GEORGETOWN, CAL.—Notice of appropriation of 10,000 inches of water of the middle fork of the American River has been filed by George L. Threlkel. The water will be utilized for power and mining purposes.

GRIDLEY, CAL.—The City Trustees have awarded the contract for installing the street lighting system to Robert M. Beebe for $2,330.

LOS ANGELES, CAL.—Plans are being considered by the Edison Electric Company for the construction of a central power plant to furnish electricity for all of the beach towns from Santa Monica to Naples. The cost of the plant is estimated at about $500,000.

OAKLAND, CAL.—The Home Telephone Company has filed a petition with the Board of Supervisors asking for a franchise to extend its telephone service into the suburbs. The residents of Fruitvale and Melrose have petitioned to have the service extended to those towns.

RED BLUFF, CAL.—The Northern California Power Company is extending its plant on North Battle Creek, north of Manton, increasing the output of the plant by 3000 hp, making the total rating 10,000 hp. A high-tension transmission line five miles long is being erected from this plant to South Battle Creek plant, which is now being constructed to furnish electricity for the construction work. The South Battle Creek plant will have an output of 5500 hp when completed. The transmission line now being erected to furnish energy for the construction work at the last-named plant will later feed the distributing lines for the Chico and Reading system. As soon as the South Battle Creek plant is finished work will commence on another plant, about five miles west and down the creek, to be known as the Inskin plant.

REDDING, CAL.—A deed has been filed by Roderick McArthur, of San Francisco, transferring to the Lava Bed Power Company 100,000 inches of water of Fall River, to be taken out of the river a mile above Fall River Mills and conveyed by a 14-mile tunnel through the mountain to Pit River, where a great fall will be obtained. The cost of the tunnel is estimated at $1,000,000. The water is to be utilized to generate electricity.

SAN RAFAEL, CAL.—The Board of Supervisors is considering the question of installing a lighting system in the county farm.

SANTA CRUZ, CAL.—M. H. Grover, of the San Vicente Lumber Company, has submitted a proposition to the City Council to furnish electricity for lighting the city at a low price.

DENVER, COL.—The right of way for an incline railway from the Moffat Road near Crags to Eldorado Springs has been granted by the State Land Board to Charles M. Einfeldt. The cost of the railway is estimated at $100,000.

DENVER, COL.—Extensive improvements and extensions are contemplated by the Colorado Telephone Company, for which an expenditure of between $700,000 and $800,000 has been authorized. Additional cables will be placed in underground conduits in Denver at a cost of $50,000. The company will also make extensive improvements in New Mexico, which will involve an expenditure of about $250,000. Improvements will be made at the Fort Collins exchange, including the installation of a switchboard. The Greeley station will be made larger, and the system in Evans will be improved.

PUEBLO, COL.—The Pueblo Suburban Traction & Lighting Company is considering the question of installing additional boilers in its power plant, and possibly a coal conveyor. The company is also planning to develop a lake for condensing purposes.

TELLURIDE, COL.—Bonds to the amount of $2,000,000 have been sold by the Telluride Power Company, the proceeds of which will be used to extend and improve its electric power systems in Colorado, Utah and Idaho. The company owns and operates five power plants and supplies electricity for lamps and motors in the towns of Telluride, Ouray, Ames, Pander and Ophir, Col.; Provo, Logan and Bingham, Utah. It also supplies part of the power for operating the system of the Utah Light & Railway Company, of Salt Lake City, and to the large mines in the vicinity of its plants. The Telluride Power Company is now constructing a large power plant at Alexander, Idaho, 125 miles north of Salt Lake City.

TRINIDAD, COL.—The Southern Colorado Power & Railway Company contemplates the construction of about two miles of additional track to its local system.

EAST BERLIN, CONN.—The citizens are considering the question of lighting the village by electricity. The New Britain division of the Connecticut Company holds a charter to light the town, and at present is furnishing electricity for lighting residences in Worthington and Kensington. It is expected that a town meeting will be called in the near future to vote on the proposition.

NEW HAVEN, CONN.—The stockholders of the United Illuminating Company have authorized the directors to issue $300,000 additional stock, bringing the total capitalization up to $1,500,000. The proceeds derived from the sale of the new stock will be used to finance important improvements and extensions, which the company is making in connection with its systems in New Haven and Bridgeport.

NORWICH, CONN.—The hydro-electric plant of the Uncas Power Company, located on the Shetucket River at Scotland, Conn., is completed and is now furnishing electricity to operate the municipal electric light plant in Norwich. The machinery at the municipal electric plant will be kept in readiness for emergencies. The Scotland power house has an output of 1200 kw, while the municipal steam plant is rated at 800 kw.

SOUTH WINDHAM, CONN.—The Connecticut Company is installing machinery in its power plant at South Windham, Conn., to increase the output of the station to supply electrical energy to operate the electric railway between Norwich and Willimantic, Conn. Electricity for operating the system will be furnished from the Greenville plant and distributed by the South Windham station.

WASHINGTON, D. C.—A South American consul reports that a concession has been granted by the government in the country in which he is located to a local firm for the establishment of an electric light plant in a town of about 9000 inhabitants. Manufacturers may secure further information by addressing No. 2902, Bureau of Manufactures, Washington, D. C.

WASHINGTON, D. C.—Notices of advertisements have been forwarded by Consul Archibald for the following public works: 1. A City Council meeting has been called for the purpose of making a loan of $250,000 for the purpose of extending the electric light works at Port Elizabeth; 2, for the extension of the city electric light systems at Christchurch, New Zealand, according to a notice in the *New Zealand Gazette*, a loan is to be made for $85,000; 3, contracts will be awarded soon for supplies for the Belgian State Railway at the Brussels Exchange. For further information address No. 2904, Bureau of Manufactures, Washington, D. C.

AUGUSTA, GA.—It is reported that Acting Mayor L. L. Kent is advocating the erection of a municipal electric light plant.

AUGUSTA, GA.—The Augusta-Aiken Railway & Electric Company has entered into a contract with the City Council of North Augusta to furnish electricity to light the streets of the city. The street lighting system will consist of 40 tungsten lamps.

GAINESVILLE, GA.—An order has been signed in Atlanta by Judge Newman, of the federal court, for the foreclosure of a mortgage on the Gainesville Electric Railway. The mortgage is held by the Knickerbocker Trust Company, of New York, trustee, and the sale of the property is ordered to take place on Feb. 20. The company's indebtedness is fixed at $279,000.

GRIFFIN, GA.—Extensive improvements to the municipal electric light plant are recommended by Superintendent J. W. Hammond, which include the installation of a 350-hp engine, direct connected to a 240-kw 2300-volt three-phase generator, with necessary piping, exciter, switches, meters, etc.; a 125-hp boiler, with stack, valves, etc. H. H. Bass is chairman of board of water, light and sewer commission.

HAWKINSVILLE, GA.—The town has voted to issue $15,000 in bonds, the proceeds to be used to establish a municipal electric light plant.

BOISE, IDAHO.—Orders have been placed by the Boise & Interurban Railroad Company with the Westinghouse Electric & Manufacturing Company for machinery for the substation at Pierce, which will double the output of the station. The additional energy will be required when the double tracking of the road from Boise is completed. The cost of the machinery is estimated at $12,000.

BELLEVILLE, ILL.—The City Council has granted a franchise to Joseph Loenger, Peter Fellner and Phillip Knapp to construct and operate an electric light, heat and power system in Belleville.

PEORIA, ILL.—Plans are being made by the Peoria Railway Terminal Company to construct about two and one-half miles of additional track during the next year.

ROCK ISLAND, ILL.—The capital stock of the People's Power Company has been increased from $1,000,000 to $2,000,000. The company proposes to make extensive improvements to both its electric and gas plants.

MONTICELLO, IND.—The Tippecanoe Electric Power Company has increased its capital stock to $100,000. The company is constructing a modern concrete power dam in the Tippecanoe River at this place.

NEW CASTLE, IND.—The city authorities have employed an expert to find out just what the cost of operating the municipal water and electric light plant is, and just what revenue they bring to the city.

SOUTH BEND, IND.—Arrangements have been completed by the South Bend Home Telephone Company for improvements to its plant, which will involve an expenditure of about $30,000.

WABASH, IND.—The Wabash Light & Power Company has awarded a contract to the Ft. Wayne Electric Works for the installation of additional electrical equipment and machinery. George L. Smith will have charge of the work.

FAIRFIELD, IA.—The Fairfield Gas & Electric Company is contemplating remodeling its plant, at an expenditure of from $35,000 to $40,000.

PITTSBURG, KAN.—The Joplin & Pittsburg Railway Company is planning to construct two extensions to its system during the coming year, which will call for the construction of from 10 to 30 miles of track. The company proposes to build one extension from Pittsburg to Cherokee, Kan., and the other to Mulberry, Kan.

MIDDLESBORO, KY.—The Middlesboro Home Telephone Company has increased its capital stock from $15,000 to $25,000.

BELFAST, MAINE.—The Penobscot Bay Electric Company has petitioned for permission to erect its transmission lines on Swan Lake Avenue and the so-called back road to Searsport for the distribution of electricity.

BRUNSWICK, MAINE.—The Brunswick Electric Light & Power Company has commenced work on the construction of a new power station in the Cove. When completed the company will utilize the water power formerly used by the old pulp mill.

BALTIMORE, MD.—The Consolidated Gas & Electric Light Company has submitted a proposition to Mayor Mahool and Superintendent of Lamps and Lighting McCuen, offering to furnish electricity to all the municipal departments at a flat rate of six cents per kw-hour, which will mean a saving of about $3,000 annually to the city. The city now pays an average of 7 1/10 cents per kw-hour. The city has decided to accept the offer, which will go into effect at once.

BOSTON, MASS.—The city has decided to abandon the city's heating and lighting plant at the Wareham Street storage building, as it can secure the service from private companies at a much less cost. George W. Morrison, superintendent of the department of public buildings, has made contracts with private concerns for lighting and heating the building, to cost $1,450 a year, which formerly cost the city $3,800 annually.

CAMBRIDGE, MASS.—The Cambridge Electric Light Company has petitioned the State Board of Gas and Electric Light Commissioners for permission to issue $20,000 in additional capital stock, the proceeds to be used for payment of floating debt and for extensions to its plant.

CLINTON, MASS.—Work has been commenced by the Connecticut River Power Company on the construction of its power station, to be located in Clinton on the Fitch Road. The cost of the building and equipment is estimated at $25,000.

GREENFIELD, MASS.—The Greenfield Electric Light & Power Company has filed a petition with the Selectmen for a franchise to extend its transmission lines from Nash's Mills to the town farm; also to erect poles on Power Square and Power Court, on Lincoln, Riddell, Haywood and Chapman Streets.

LAWRENCE, MASS.—Permission has been granted to the Lawrence Gas Company to erect and maintain transmission lines on Lowell, Cross, Essex, Broadway, Lawrence and Arlington Streets for the distribution of electricity.

LEE, MASS.—The 225-hp engine in the plant of the Lee Electric Company broke down Dec. 11, causing a loss of about $2,000. The electric company has made arrangements with the Monument Mills plant at Glendale to supply electricity to operate its system until repairs can be made, which will take about three weeks.

NEWTON, MASS.—Plans are being made by the Newton Street Railway Company to double track about five miles of its railway during the coming year.

NORTH ABINGTON, MASS.—Electricity for operating the Rockland & Abington Electric Light & Power Company system is now supplied from the East Bridgewater station. The local plant will not be dismantled.

SOUTHBRIDGE, MASS.—The Central Mills Company is installing a generator in its plant to furnish electricity to light its mills.

UPTON, MASS.—A petition has been presented to the Board of Selectmen by the citizens of the town asking the board to grant the Upton Electric Light Company permission to erect transmission lines on the principal streets of the town. The board has refused to grant the company permission, as it was not willing to furnish electricity to light the town hall for half price during the life of the franchise asked for. The company has submitted a proposition to the Selectmen offering to furnish 32-cp incandescent lamps, 17 to the mile, at $15 per lamp per year, on a moonlight schedule. It is estimated that the town could be lighted by electricity for $1,000 per year. The town appropriated $700 in 1908 to light the streets with kerosene lamps.

WATERTOWN, MASS.—The Board of Selectmen has entered into a contract with the Newton & Watertown Gas Light Company for lighting the streets of the town for a term of 10 years. The company agrees to replace the 25-cp incandescent lamps now in use with tungsten lamps of 40 cp, and also a reduction in the price of electricity to private consumers from 18 cents to 12 cents per kw-hour after Jan. 1, 1909. Under the new contract the 47 arc lamps will cost the town $4,060, and $7,941 for 533 incandescent lamps, which will reduce the cost of street lamps $959 per year. Electrical energy for operating the system is furnished by the Edison Electric Illuminating Company, of Boston, Mass.

WEST BOYLSTON, MASS.—The citizens have voted to have the streets of the town lighted by electricity. The Marlboro Electric Light Company has submitted a proposition to install a plant and light the town, or, should the town prefer to operate its own system, to furnish electrical energy for the same. In return for a five-year contract the company offers to install a plant in the town and furnish 120 tungsten lamps of 40 cp on a moonlight schedule until midnight for $18 per lamp per year, and to furnish five lamps free. The company also gives the town the privilege to purchase the plant at any time after completion by giving six months' notice at net cost plus 10 per cent of the contractors' charges and 15 per cent on the cost of labor. The cost for town equipment not to exceed $11,530 and the amount for 25 commercial customers not to exceed $50 each, making a total of $12,780. In case the town should prefer to own the plant from the start the Marlboro Electric Light Company agrees to build the plant and to supply electricity at 2300 volts for a term of five years at five cents per kw-hour. The company agrees to have the plant installed and ready for operation by July 1, 1909, if awarded the contract.

ANN ARBOR, MICH.—Arrangements are being made by the Michigan State Telephone Company to repair its overhead system in this city at a cost of about $40,000.

AU SABLE, MICH.—The Eastern Power Company has been granted franchises by the village of Au Sable, Oscoda Township and Omer to construct and maintain transmission lines for the distribution of electricity for lamps and motors.

BESSEMER, MICH.—The City Council is considering the question of establishing a municipal electric light plant. The present contract for electric lighting expires within a year.

DETROIT, MICH.—The Public Lighting Commission is considering plans for increasing the output of the municipal electric light plant, which include the installation of one 2000-kw turbo-generator and a 300 or 400 hp boiler. Frank Mistersky is general superintendent of the plant.

MUSKEGON, MICH.—Plans are being made by the Grand Rapids-Muskegon Water Power Company for further development of the water power of Muskegon River, with a third power station. The company is purchasing land along the river near Big Rapids. George L. Erwin is secretary.

FERTILE, MINN.—Owing to the owners of the local electric light plant and the Village Council being unable to come to an agreement, the electric lighting service will be discontinued after Jan. 1, 1909. The company claims to be unable to furnish the service at the present rate, 10 cents per kw-hour, and wishes to increase the price by 50 per cent. Charles H. Sparber is electrician.

KASOTA, MINN.—The citizens have voted to issue bonds to the amount of $1,000 to install an electric lighting system.

ST. PAUL, MINN.—The Great Northern Railroad Company is installing a telephone system for train despatching purposes on the Minot division, which is 239 miles long. When completed the telephone system will be extended from Williston to Culbank, Mont., a distance of 437 miles, and also along the Butte division, 507 miles in length.

ST. PAUL, MINN.—The contract for street lighting for 1909 was awarded by the Board of Aldermen to the St. Paul Gas Light Company. The bid of the company for furnishing electricity for arc lamps, both on the underground and overhead systems, was $1 less per arc lamp than paid under the present contract. For arc lamps furnished in the underground system the company agrees to furnish at $95 per lamp per year and those by the overhead system at $85 per lamp per year. For all additional lamps for the overhead system above the 89 now in use the city is to pay at the rate of $8 per month per lamp, and for all additional arc lamps in the underground system $9 each per month. The city now has 800 lamps operated under the underground system. For furnishing and main-

taining incandescent lamps on the river bridges and piers and alleys the rate is $2 per lamp per month.

VERNDALE, MINN.—An election will soon be held to vote on the proposition of granting a franchise to K. Bagne to construct and operate an electric light plant in Verndale.

WADENA, MINN.—K. Bagne, of Verndale, Minn., is considering the question of furnishing electricity for lamps in Wadena.

HATTIESBURG, MISS.—Plans are being considered by Mayor J. H. Donald for the construction of a municipal electric light plant, for which a preliminary survey has been made of the Bouie River, just above its confluence with Leaf River, two miles from the city. The cost of the plant is estimated at $150,000. J. H. Putnam, of Hattiesburg, Miss., is engineer.

DOWNING, MO.—Plans are being made by J. M. St. Clair & Son to rebuild the telephone exchange at Downing, and also to establish a system at Grand Cane, La.

KANSAS CITY, MO.—The Council has passed an ordinance locating lamps from Santa Fé to Mulberry Street; also locating 200 other lamps.

ST. LOUIS, MO.—The Downtown Lighting Association, organized to select a uniform lighting system for the business district of St. Louis, will commence work on Jan. 1. The association proposes to install the system and turn it over to the city, provided the latter agree to maintain it. The district to be lighted is bounded by Market Street and Washington Avenue, Twelfth and Fourth Streets.

SALEM, MO.—An election will be held to vote on the proposition to issue bonds for the extension of the city's electric light plant.

LEWISTON, MONT.—The Fargo Electric Company, of Fargo, N. D., was awarded the contract for installing the electric fixtures in the court house, for $4,000.

STEVENSVILLE, MONT.—Two applications for electric light franchises have been presented to the City Council. One was presented by C. B. McCarthy and the other by G. W. Messer and Mr. Featherstone.

BLUE SPRINGS, NEB.—Black Brothers are contemplating installing an electric light plant in Blue Springs in the near future.

NEWPORT, N. H.—The Newport Electric Light Company is building a large addition to its power house and will install additional equipment, including another boiler, a 750-hp engine and generator.

BELLEVILLE, N. J.—The township committee has decided to advertise for bids for street lighting before signing the contract submitted by the Public Service Corporation, which now furnishes the street lighting service at the rate of $12 per year for each incandescent lamp. The contract has expired and the company proposes to raise the price to $15 per year for each lamp. It is said that the Newark Block Lighting Company may submit a proposition to light the town.

NEWARK, N. J.—A factory has been rented for the Radial Telegraph & Telephone Company at 16-22 Boyden Place, Newark, N. J., which will be equipped with machinery for the manufacture of wireless apparatus. All machines will be motor driven, and it is understood that no purchases have yet been made. The Ellsworth Company is fiscal agent for the company.

MANCHESTER, N. Y.—Arrangements are being made by the Lehigh Valley Railroad Company to light its yards and buildings in Manchester by electricity. A contract for wiring has recently been let.

MASSENA, N. Y.—The St. Lawrence River Power Company has awarded a contract to the Dayton Globe Iron Works, Dayton, Ohio, for two water turbines, with a total rating of 12,000 hp. The turbines, together with generators, will be installed during the coming spring.

SCHENECTADY, N. Y.—Electricity for operating the Schenectady Railway is now received from the new generating station erected by the General Electric Company on the Hoosick River near Schaghticoke. The plant has an output of 15,000 kw.

SCHENECTADY, N. Y.—The Schenectady Power Company is reported to be making plans for the construction of another large storage dam on the Walloomsac Creek, near Walloomsac. A power plant will be erected at the dam to generate electricity, which will be transmitted to Johnsonville on the present transmission line.

CHARLOTTE, N. C.—The Southern Power Company is hurrying the completion of its plant at Rocky Creek station, in South Carolina, where 40,000 hp will be available within a few weeks, in order to meet contracts for power. The contract has also been let for the completion of the plant at Ninety-nine Islands, on the Catawba River, in South Carolina, where 18,000 hp will be available. This latter contract amounts to $650,000. The Southern Power Company will have an output of 110,000 hp. Of this amount about four-fifths has been taken by cotton mill plants in the Piedmont section of North and South Carolina.

ELIZABETH CITY, N. C.—The construction of an electric railway to the town of Weeksville is being promoted. It is proposed to organize a company with a capital stock of about $100,000.

HIGH POINT, N. C.—The Southern Power Company has perfected arrangements with the High Point Electric Company to bring its transmission lines into the town.

HIGH POINT, N. C.—The North Carolina Electric Company, recently purchased by E. D. Steele and others, will soon be reorganized and the original plans of the company put into execution, according to a statement made a few days ago by Mr. Steele.

HETTINGER, N. D.—The question of establishing an electric light plant in Hettinger is reported to be under consideration.

BOWLING GREEN, OHIO.—The Lake Erie, Bowling Green & Napoleon Railway Company contemplates extending its system from Bowling to Tontogany, a distance of six miles, during the next year.

DELPHOS, OHIO.—The Delphos Manufacturing Company has arranged to increase its steam power plant and will install a number of generators. Motors will be placed in each department to operate the machinery.

KENMORE, OHIO.—Thomas L. Childs, promoter of the Turkeyfoot Traction Company, has applied to the Village Council for a franchise to construct and operate an electric railway in Kenmore.

WARREN, OHIO.—S. Stoughton, of Warren, Ohio, is interested in a project to construct an electric railway from Painesville.

ARDMORE, OKLA.—L. S. Dolman is advocating the development of the water power of the Washita River to be utilized to generate electricity. It is said that sufficient power could be developed to operate all the manufacturing plants in the city; also to operate the street and interurban electric railways.

EL RENO, OKLA.—We are informed that the El Reno Gas & Light Company contemplates the installation of an additional unit to supply energy for the street railway system. The additional equipment will probably include a 500-kw, 25-cycle unit. The cost of the work is estimated at $20,000. H. H. Stephens is general manager.

GUTHRIE, OKLA.—The Guthrie Street Railway Company, it is stated, will commence work at once on the extension of its Oklahoma Avenue line to Capitol Hill.

HOOKER, OKLA.—Bonds to the amount of $20,000 have been voted by the city for the construction of an electric light plant and water works system, to be completed and in operation by May 1.

NEWBERG, ORE.—The Yamhill Electric Company contemplates the installation of an additional boiler of 250 hp.

PORTLAND, ORE.—The Oregon Electric Railway Company contemplates extending its electric railway from Albany to Salem during the coming year. G. W. Talbot is general manager.

CHARLEROI, PA.—The West Penn Electric Company contemplates the erection of a power plant in Charleroi, Pa., if satisfactory arrangements can be made with the town.

FORD CITY, PA.—The citizens on Dec. 17 voted to issue $16,000 in bonds, the proceeds to be used for the construction of an electric light plant. D. O. Crouch is clerk.

JOHNSTOWN, PA.—W. E. Hildebrand is interested in a project to construct an electric railway from Johnstown to Somerset. The railway will be operated under the name of the Johnstown & Somerset Street Railway Company, and will probably use the Pennsylvania & Maryland line for right of way and connection.

PHILADELPHIA, PA.—Plans are being prepared for the Hydro-Electric Company for a water power plant to be erected on Main Street, Manayunk, on the Schuylkill River.

PHILADELPHIA, PA.—The Spreckels Sugar Refining Company, of Philadelphia, Pa., has awarded a contract to the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., for a complete power plant. The equipment will include two 900-hp turbines and generators, 12 75-hp motors, switchboard and other necessary apparatus.

READING, PA.—Application will be made to Governor Stuart for a charter on Jan. 5 for the Penn Electric Company by John C. Amendt, Thomas C. Yarrington, Jr., and Harry F. Kantner. The company proposes to supply electricity in Reading and Berks Counties for lamps and motors.

SCRANTON, PA.—Plans are being considered to increase the output of the plant of the Scranton Electric Company to meet the demands for electrical energy between Scranton and Carbondale, at an expenditure of about $250,000. The work contemplates centralizing the power in the central and suburban plants and abandoning several substations.

SHARON, PA.—Application will be made Jan. 5 for a charter for the Mercer County Trolley Company, which proposes to construct an electric railway line in Greenville, and ultimately connect Sharon and Mercer. James M. Campbell, Lyle W. Orr, Frank Filer and S. D. Downs are interested in the project.

SOUTH BETHLEHEM, PA.—The City Council is considering the question of establishing a municipal electric light plant.

WASHINGTON, PA.—The Washington & Canonsburg Railway Company contemplates the construction of six miles of new track during the coming year.

WASHINGTON, PA.—Application has been made for a charter for the Slatedale Electric Light, Heat & Power Company for the purpose of supplying electricity for light, heat and motors in the Township of Washington and surrounding country. Wilson Rex, H. W. Bloss, C. J. Bloss and Victor S. Wertman are interested in the project.

BLACKSBURG, S. C.—The city is contemplating a bond issue of $15,000, the proceeds to be used to establish an electric lighting system and for other purposes.

RIDGEWAY, S. C.—The Southern Power Company, of Charlotte, N. C., has completed a deal whereby the company has secured options on about 40,000 acres of land on the Wateree River, extending from Wateree Creek to Getty's Shoals, for future development.

SPARTANBURG, S. C.—The Electric Manufacturing Company, which has developed an electric power plant at Gaston Shoals, on Broad River, 30 miles distant, is building transmission lines to Woodruff, S. C., to supply electricity to the cotton mills of that town; preparations are also being made to supply several textile plants at Cowpens. Electricity for operating the electric railway system at Spartanburg and the municipal lighting are also furnished by this company.

MADISON, S. D.—It is reported that plans are being considered to rebuild and enlarge the municipal electric light plant.

SIOUX CITY, S. D.—The property of the Citizens' Telephone Company, which was purchased last September by Harry Wescott, of Sioux City, has been assigned to the New State Telephone Company, which has already taken charge of the system and will operate it in connection with its telephone lines in Iowa.

DYER, TENN.—The Dyer Ice & Coal Company is contemplating installing a new engine in its plant and also contemplates establishing a meter system. F. E. Menzies is manager.

McKENZIE, TENN.—Application will be made by the town to the next Legislature for permission to vote on the proposition to issue $50,000 in bonds, the proceeds to be used to establish a street lighting system and for other purposes.

AUSTIN, TEX.—The Austin & Lockhart Interurban Railway Company, which has been promoting the construction of an electric railway between Austin and Lockhart, a distance of about 30 miles, is said to be almost ready to start construction work.

BEEVILLE, TEX.—It is reported that the Beeville Water & Light Company will rebuild its water and light plant. J. C. Hanie is secretary and manager.

BROWNSVILLE, TEX.—Col. S. W. Fordyce, of St. Louis, Mo., and associates, owners of the old Rio Grande Railway, which runs from Brownsville, Tex., to Point Isabel, a large pleasure resort, will soon begin the work of converting the line into electric traction. This road is 22 miles long.

COLLEGE STATION, TEX.—R. T. Milner, president of the Agriculture and Mechanical College, has recommended to the Legislature the construction of an electric railway from College Station to Bryan by the State; cost estimated at $70,000.

DEL RIO, TEX.—The capital stock of the Del Rio & Western Telephone Company has been increased from $20,000 to $60,000.

EL PASO, TEX.—The County Commissioners have granted J. A. Happer a franchise to construct an electric railway from the Fort Bliss Electric Railway to the Government Hill addition.

HARLINGEN, TEX.—Leon Hill, of Harlingen, Tex., is promoting the building of an electric railway between Harlingen and Brownsville.

PORT ARTHUR, TEX.—John W. Gates, of Port Arthur, Tex., is said to be back of a project to build an interurban electric line between Beaumont and Port Arthur. The proposed line will be about 20 miles long, for which surveys have already been made.

SAN ANTONIO, TEX.—The proposition of building an interurban electric line between San Antonio and New Braunfels, a distance of 30 miles, is said to be under consideration by the Stone-Webster syndicate, of Boston, Mass.

SHERMAN, TEX.—The North Texas Telephone Company has increased its capital stock from $52,000 to $60,000.

TERRELL, TEX.—Arrangements are being made for the construction of a municipal electric light plant. W. C. Drake is superintendent.

AMERICAN FORK, UTAH.—Surveys are being made by Richard R. Lyman, of Salt Lake City, Utah, consulting engineer, for a power plant to be constructed by the Utah County Light & Power Company at a cost of more than $100,000. A steel pipe line is to be erected in connection with the plant.

SALT LAKE CITY, UTAH.—The Utah Light & Railway Company has awarded a contract to James Kennedy, of Salt Lake City, for the construction of a large conduit in this city to cost $22,000.

EMPORIA, VA.—The Greensville Water Power Company has awarded contracts to Stamper Brothers & Ragland and Holland & Myers, of Richmond, Va., for the construction of a dam across Meherrin River in connection with the construction of a proposed hydro-electric plant. The dam will cost about $150,000. The company will expend about $75,000 additional in equipment and in taking over the local electric light and telephone systems, both of which will be rebuilt. P. E. Burgwyn, of Richmond, Va., is engineer.

SOUTH HILL, VA.—An ordinance providing for granting a franchise for the construction of an electric light system has been approved by the Mayor.

MONTPELIER, VT.—A bill has been introduced into the Senate to incorporate the Montpelier & Essex Junction Traction Company. The company will be capitalized at $50,000 and proposes to construct an electric railway to extend through Berlin, Middlesex, Moretown, Waterbury, Richmond, Hinesburgh, Jericho, Colchester and Underhill. The incorporators are: F. M. Corry, L. E. Taft, W. T. Dewey and E. H. Deavitt, of Montpelier, Vt.; A. L. Hewitt, of Berlin, Vt.; D. E. Moody, of Waterbury, Vt., and others.

OLYMPIA, WASH.—The State Building Commission will call for bids for the installation of electric fixtures in the Governor's mansion.

SEATTLE, WASH.—The capital stock of the Loyal Heights Railway Company has been increased from $300,000 to $1,000,000, the proceeds to be used to double track the railway and extend it to the Country Club. The company operates an independent car line from Ballard to Golden Gardens. H. W. Treat, E. B. Cox and others are interested in the company.

MORGANTOWN, W. VA.—Arrangements are being made by the Morgantown & Interstate Railroad Company for extending its system from Morgantown to Star City, W. Va., and Point Marion, Pa., which will require the construction of about 12 miles of track.

SPOONER, WIS.—The contract for furnishing the village with meters in connection with the municipal electric light plant was awarded to the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa.

VANCOUVER, B. C., CAN.—Arrangements are being made by the British Columbia Electric Railway Company to construct an electric railway from Vancouver to the eastern boundary of Hastings town site. R. H. Sperling is general manager.

BRIDGEWATER, N. S., CAN.—The Micmac Mining Company has made application for a charter to develop water power on the Port Medway River, from which it is proposed to erect a transmission line to the Liepigate mining district for furnishing electricity to the Micmac and other mines. The company also proposes to operate an electric railway for passenger and freight service.

OTTAWA, ONT., CAN.—Owing to low water in the Bonnechere River, the plant of the Renfrew Power Company has been compelled to close down.

WOODSTOCK, ONT., CAN.—A. N. Warfield, Toronto, Ont., is arranging the preliminary work in connection with the construction of the Woodstock & Guelph Electric Railroad.

ESTEVAN, SASK., CAN.—A rural telephone company is being formed to build a telephone line from here to Ambrose and Hamar. For further information address H. Yardley.

KILLAM, SASK., CAN.—Plans are being made to construct a telephone line from Killam to the district south of town. For further information address J. A. Neely.

CHIHUAHUA, MEX.—Governor Enrique C. Creel, of Chihuahua, former Mexican Ambassador to the United States, and associates, who own the local street railway system, are converting it into electric traction and making many other improvements to the property.

GUADALAJARA, MEX.—The Compania de Tranvias, Luz y Fuerza, which owns and operates the electric railway and light and power systems in Guadalajara, has recently increased its capital stock from $3,000,000 to $8,500,000. It is said that this company contemplates many important improvements during the coming year.

GUADALAJARA, MEX.—Manuel Gallardo Cuesta and associates are interested in a project to build an electric railway between Guadalajara and Chapala, about 80 miles in length. It is reported that ex-Governor David R. Francis and son, of St. Louis, Mo., are interested largely in the enterprise.

GUADALAJARA, MEX.—The Soledad Development Company has taken preliminary steps toward building an electric railway between Guadalajara and Mezquital del Oro, situated in the State of Zacatecas, a distance of about 65 miles. Power for operating the road will be furnished from a hydro-electric plant which will be installed on the Santiago River, near Guadalajara. The proposed road will do a freight as well as passenger business.

HERMOSILLO, MEX.—A company is being organized at Hermosillo, State of Sonora, to acquire the branch line of the Sonora Railroad which runs from La Union Junction to Hermosillo. It is planned by the prospective new owners to adopt electric traction and to establish a passenger service between its two terminal points.

MATAMOROS, MEX.—Col. S. W. Fordyce, of St. Louis, Mo., and associates, who purchased the Matamoros & Santa Cruz mule car line several months ago, will rebuild the road and install electric traction as soon as the proposed international bridge is built across the Rio Grande River at Brownsville. The Matamoros & Santa Cruz Railway runs between the ferry landing opposite Brownsville, Tex., to Matamoros, a distance of about three miles. It is planned by its new owners to extend it to the National Railroad Depot, a distance of about two miles from its present terminus.

MEXICO CITY, MEX.—Extensions and improvements are being considered by the Mexico Tramways Company and arrangements completed with the government officials, according to the statement of Dr. F. S. Pearson, of New York, president of the company. The work contemplated will involve an expenditure of about $5,000,000 gold during the next three years.

ORIZABA, MEX.—The Compania Empresa Electrica, which has been organized at Orizaba, will expend about $300,000 in the construction of an electric railway system in that city.

TAMPICO, MEX.—S. Pearson & Son, Ltd., who built and own the new electric street railway system in Vera Cruz, will, it is reported, construct a similar system in the City of Tampico and build interurban lines to various towns in that section. This firm is developing extensive oil fields in the Tampico territory.

New Industrial Companies.

THE SECURITY LIGHT & TANK COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $10,000, by Henry Bandlow, Frank Matthies and Arthur J. Shutan. The company proposes to do a general electrical, heating, manufacturing and merchandise business.

THE McPHERSON-WILLARD FORGE & MACHINE COMPANY, of Camden, N. J., has been incorporated, with a capital stock of $75,000, by White D. Willard, Phillip L. Swank and Theodore Carter. The company proposes to conduct an electrical and mechanical engineering business.

THE JOHN B. CARTER COMPANY, of East Orange, N. J., has been incorporated by C. O. Geyer, F. E. Ruggles and G. G. L. Valle, of East Orange, N. J. The company proposes to do a general contracting, engineering and construction business. The company is capitalized at $150,000.

THE NATIONAL ELECTRIC WIRING & FIXTURE COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $5,000, by Rudolph W. Yates, George Smithlin and Henry N. Brande, all of New York, N. Y. The company proposes to do electrical work of all kinds.

THE BENTON INSULATING COMPANY, of Elmira, N. Y., has filed articles of incorporation, with a capital stock of $50,000, for the purpose of manufacturing electrical apparatus . The incorporators are: C. F. Riddle, E. J. Baldwin, T. Allison, of Elmira, N. Y., and J. S. Wheeler, of Penn Yan.

THE WEST JERSEY ELECTRICAL & CONSTRUCTION COMPANY, of Camden, N. J., has been chartered, with a capital stock of $25,000, by F. Fithian, H. T. Sutherland and L. S. Fithian, of Camden, N. J. The company proposes to do a general contracting, mechanical and electrical engineering business.

THE WESTERN ENGINEERING COMPANY, of New York, N. Y., has been chartered, with a capital stock of $6,000, to do a general contracting, mechanical and electrical engineering business. The incorporators are: Samuel McCullough, of Brooklyn, N. Y.; G. Q. Dean and Fred Knowlton, of New York, N. Y.

THE STELLAR COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $9,000, by Benjamin B. Hamlin, Jr., of New York, N. Y.; William G. Conn., of Brooklyn, N. Y., and Ashton M. Boney, of New York, N. Y. The company proposes to establish a physical, electrical and chemical laboratory.

THE WILLIAM H. WOOD LOCO FIRE BOX & TUBE PLATE COMPANY, of Camden, N. J., has been chartered, with a capital stock of $500,000, by John Creth Marsh, Frank B. Rhodes and William R. T. Kolp. The company proposes to manufacture fire boxes, tube plates, etc.; also to carry on a mechanical and electrical engineering business.

THE NEW ERA NOVELTY COMPANY, of East Orange, N. J., has filed articles of incorporation, with a capital stock of $100,000, and proposes to manufacture mechanical, electrical and chemical devices for household and general use. The incorporators are: W. R. Moore, of East Orange, N. J.; C. W. Groo, of Newark, N. J.; D. E. Denniston, of South Fallsburg, N. Y.

New Incorporations.

PELL CITY, ALA.—The St. Clair County Telephone Company has been chartered, with a capital stock of $10,000, by L. Cooke, J. F. Cooke, E. Cooke and others.

BOONEVILLE, ARK.—Articles of incorporation have been filed for the Booneville Light & Water Company, with a capital stock of $50,000, for the purpose of constructing and operating water works system, electric light and power plant and telephone exchange. The officers are: John T. Thayer, president; Joseph Ellerkamp, vice-president, and W. Earl Harrell, secretary and treasurer.

BERKELEY, CAL.—The Sierra Electric Power Company has filed articles of incorporation, with a capital stock of $500,000. The company proposes to develop the mountain streams of the Sierra and erect a large generating plant in the mountains for the distribution of electricity in Berkeley.

VISALIA, CAL.—The Lindsay Home Heat, Light & Power Company has been chartered, with a capital stock of $50,000. The directors are: Charles F. Burr, W. S. Berry, L. H. Green, C. O. Cowels and P. T. Ostrander.

COLORADO SPRINGS, COL.—The San Bernardo Mining & Power Company has been incorporated, with a capital stock of $50,000, by Thomas J. Fisher, Edmond C. Van Diest and Horace G. Lunt.

HAHIRA, GA.—The Hahira Telephone Company has been formed with L. M. Stanfill, president, and R. Y. Scruggs, secretary.

BLUFFTON, IND.—The Bluffton, Berne & Celina Traction Company has filed articles of incorporation with a capital stock of $50,000. The company proposes to generate and distribute electricity in addition to the operation of an interurban railway 47 miles long, connecting the cities named in title and intermediate towns. The principal office will be in Bluffton.

PAXTON, IND.—The Paxton Telephone Company has been incorporated with a capital stock of $5,000. The object of the company is to build, equip and operate a telephone system and exchange in Paxton and throughout the eastern portion of Sullivan County. Jacob Cox, John and Alva McCannon and John Nesbit are directors.

FRANKFORT, KY.—Articles of incorporation have been filed with the Secretary of State for the Davis Telephone Company, of Whitley County. The company is capitalized at $1,000 and the incorporators are: A. B. Johnson, M. A. Maurey, W. B. Davis and others.

WILLIAMSBURG, KY.—The Davis Telephone Company has been incorporated by A. B. Johnson, M. A. Maurey, W. B. Davis and others.

LEBANON, MO.—The Laclede County Telephone Company has been chartered, with a capital stock of $10,000, by J. E. Dickens, B. C. Hooper, Thomas Gilmer, Martin D. Johnson and others.

DISNEY, NEB.—The Spring Branch Telephone Company has been incorporated, with a capital stock of $5,000. W. S. Roberts, of Disney, is president of the company.

KEARNEY, NEB.—Articles of incorporation have been filed for the Kearney Water & Electric Power Company, with a capital stock of $310,000, by N. P. McDonald, Arthur A. Scoutt and William J. Scoutt.

CAMDEN, N. J.—Articles of incorporation have been filed for the Martinsburg & Charleston (W. Va.) Gas & Water Company, with a capital stock of $300,000. The incorporators are: William P. Huston, John H. Blyo and William Goodwin. The company proposes to deal in electricity and gas.

CLAREMORE, OKLA.—Articles of incorporation have been filed for the Claremore Street Railway Company, with a capital stock of $300,000, by W. J. Perdue, C. F. Goabey, O. C. Wing, H. Jennings and Hiram Stephens. The company proposes to construct a street railway in Rogers County.

WAURIKA, OKLA.—The Waurika Ice & Electric Company has been chartered, with a capital stock of $50,000, by M. C. Irwin, M. Griffin O'Neal, of Dallas, Tex.; F. B. Martin and E. W. Gnatt, of Waurika, Okla.

HALFWAY, ORE.—The Panhandle Co-operative Telephone Company, of Pine Valley, has been incorporated, with a capital stock of $4,500. Charles B. Davis is president.

OREGON CITY, ORE.—The Clackamas Southern Railway Company has been incorporated by F. M. Swift, David Loring and A. E. Clark. The company proposes to construct an electric railway to connect Oregon City with the Molalla Valley in Clackamas County, with a southern terminus at Scott's Mills on Butte Creek. Preliminary surveys have been completed and most of the right of way secured. The railway will be about 35 miles in length and the company expects to develop water power to generate electricity to operate the road.

MARION CENTER, PA.—The Marion Center Telephone Company has been organized, with the following-named officers: H. P. Wetzell, president; Dr. L. N. Park, vice-president; Dr. A. H. Stewart, secretary, and William C. Griffith, treasurer.

MERCER, PA.—The Blacktown Telephone Company has been incorporated, with a capital stock of $1,150, to erect and operate a telephone system in Mercer County, with principal exchange in Blacktown. The directors are: F. W. Gilson, of Mercer, Pa., treasurer; W. R. Nelson, Earl S. Rudolph, J. C. Williamson, of Springfield Township; W. W. McMasters, of Findley, and A. W. Urey, of Pine Township.

MT. CARMEL, PA.—The Mt. Carmel & Locust Gap Transit Company has been incorporated, with a capital stock of $30,000, to build a railway from St. Marys Cemetery and Locust Gap, a distance of two and one-quarter miles. The directors are: Edmund W. Samuel, of Mt. Carmel, Pa., president; William Kiefer, Jr., Thomas J. Kiefer, Joseph D. McConnell and Robert D. Heaton.

PHILADELPHIA, PA.—The Allegheny & Northwestern Railroad Company has been incorporated, with a capital stock of $70,000, to construct a railway between Mars and Evans City, a distance of seven miles. The directors are: John G. McPherson, president; David Dilinger, William E. Heller, C. S. Jarvis and J. L. Killip, all of Philadelphia, Pa.

PITTSBURG, PA.—The Scott Township Street Railway Company has filed articles of incorporation, with a capital stock of $30,000. The directors are: W. E. Kusen, of Pittsburg, Pa., president; A. J. Schmidt, of Pittsburg, Pa.; C. August Stuetz, of Bellevue, Pa.; W. P. Heckman, of Avalon, Pa., and J. D. C. Miller, of Sewickley, Pa.

PITTSBURG, PA.—A charter has been granted to the Banksville & West End Street Railway Company by W. E. Kusen, A. J. Schmidt, C. A. Steutz, W. P. Heckman and J. D. C. Miller. The company is capitalized at $18,000 and proposes to construct a street railway three miles long in the vicinity of Banksville.

SUNBURY, PA.—The Sunbury Electric Company has been chartered, with a capital stock of $5,000. The directors are: Boyd A. Musser, of Scranton, Pa., treasurer; Guy Webster, of York, Pa., and William H. Lyons, of Sunbury, Pa.

HAYTI, P. O. VIENNA, S. D.—The Hamlin County Farmers' Telephone Company has been chartered, with a capital stock of $25,000.

FORT WORTH, TEX.—The Polytechnic Light & Power Company, of Polytechnic Heights, has been incorporated, with a capital stock of $15,000, by D. R. Aikin, R. H. Fulton and E. V. Evans.

GRAND SALINE, TEX.—The Grand Saline Light & Power Company has been chartered, with a capital stock of $10,000, by U. S. Meeks, Joseph Reutz and C. E. Stromberg.

SOMERVILLE, TEX.—Articles of incorporation have been filed for the Somerville Electric Light & Manufacturing Company, with a capital stock of $10,000, by R. E. Bledsoe, J. D. Gidings, E. F. Reynolds and others.

RUTLAND, VT.—The Otto Creek Electric Railway Company has

been organized, with a capital stock of $50,000, for the purpose of constructing an electric railway connecting Rutland, Clarendon, Wallingford, Danby, Dorset and other towns. H. B. Barden, of Wallingford, Vt., is interested in the project.

SEATTLE, WASH.—Articles of incorporation have been filed for the Peninsula Light & Power Company, with a capital stock of $400,000. The company proposes to develop water power on the Dusewallips River and to furnish electricity for lamps in Bremerton, Port Orchard and Charleston. R. S. Chapman, of Tacoma, Wash., is president, and John Arthur, of Seattle, is vice-president.

WALLA WALLA, WASH.—Articles of incorporation have been filed for the Columbia & Walla Walla Traction Company, with a capital stock of $1,000,000. The company proposes to take over the property and holdings of the old Columbia & Walla Walla Traction Company. The following named officers have been elected: Dr. N. G. Blalock, president and general manager; M. R. Hanger, of Dayton, Wash., first vice-president; L. C. Davidson, secretary, and George Kellough, treasurer.

CONCORD, W. VA.—The Capon Telephone Company has been incorporated by G. K. Kump and others.

STURGEON BAY, WIS.—The Sawyer & Western Telephone Company has been incorporated, with a capital stock of $600, by Christopher Hanson, John A. May and George O. Whitford.

GALLINGERTOWN, ONT., CAN.—The Stormont Telephone Company has been organized, with a capital stock of $1,500, and the following-named officers: Dr. E. E. Brown, of Aultsville, president; W. A. Edwards, of Gallingertown, vice-president, and W. H. Alexander, of Pleasant Valley, secretary and treasurer.

MOUNT FOREST, ONT., CAN.—The Mount Forest, Wellington & Grey Telephone Company has been incorporated with a capital of $10,000. The directors are R. O. Kilgour, J. J. Cook, Mount Forest; W. H. Wallace, Egrement Township.

Legal.

CURRENT TO FARMERS.—An interesting question as to service came up recently in Iowa. Last spring several farmers between Alden and Iowa Falls, along the line of the electric light circuit running between the towns, brought an action to compel the company to furnish electric currents to them for light and power. At the November term of court in Eldora Judge Lee held that each farmer must prosecute his own case alone, and that all of the plaintiffs could not join in the action. Accordingly the case of A. G. Wood vs. the Peterson Heat, Light & Power Company was tried. Judge Lee has rendered his decision in favor of the defendant company. It appeared from the evidence that at the time the line was constructed the president and secretary of the company represented to farmers along the line that they could be furnished with the electrical energy, and as a matter of fact they were so furnished for a time until the transformers burned out, when the company refused to replace them, and the action was brought to compel the company to re-establish the service. The court found, however, that no valid contract had been made between the parties, and dismissed the action. It is certainly striking to find farmers going to law to compel electric service.

ELECTRIC LIGHT COMPANY NOT LIABLE FOR INJURIES TO TRESPASSERS.—An electric light company is not liable for the death of a trespasser on the roof of a building through coming in contact with a live wire, which had become charged with electricity through the failure of the company to comply with city ordinances. The case in which this holding was reached may be thus briefly stated: A negro boy about 12 years old went with a companion near the same age to the roof of the Dundee Building, in Fort Worth, Tex., passing up a stairway and out through a trap-door, and was there instantly killed by coming in contact with a live guy wire, which had become charged with electricity through the failure of the company to comply with one or more of the penal ordinances of the city of Fort Worth. This suit was brought by the parents of the deceased boy against the company to recover damages on account of its failure to comply with the ordinances.

In the case of City of Greenville vs. Pitts (Texas), 107 S. W., 50, referred to in the certificate, it was distinctly held that the city was not liable for the injury inflicted in that case, for the reason that the plaintiff went upon the building in pursuit of his own business, without invitation or express permission from the owner thereof. This was in accordance with the ruling in the case of Brush Electric Light & Power Company vs. LeFevre, 57 S. W., 640, which is also referred to in the certificate. The reasoning of the court upon which that opinion is based is that, since there was not a scintilla of evidence that the awning over which the wires were stretched "had ever been used by any person as a place of resort, either for pleasure or business," therefore the injury could not have been anticipated, and the defendant was not liable. In that case there was an attempt to plead an ordinance, making it the duty to keep its wires insulated, but a special demurrer was sustained to the allegation for vagueness of pleading. There is not a suggestion in the opinion in the case that if the ordinance had been well pleaded it would have made any difference. It is almost universally held that the violation of a statutory duty is negligence *per se*. But as we understand it this is the difference between negligence at common law, usually a question of fact, and the violation of a statutory duty—"only this and nothing more." When a plaintiff sues for the neglect of the provisions of a statute or of the ordinance of a city, and proves such violation, and that he has been injured as the proximate cause thereof he has established the first postulate in his case; that is, the negligence of the defendant. But this does not preclude the defendant from showing that he has been guilty of contributory negligence. Burnett vs. Fort Worth Light & Power Company, Court of Civil Appeals, of Texas, 112 S. W., 1040.

Personal.

MR. R. T. FEWELL has taken charge of the plant of the Carolina Light & Power Company in Rock Hill, S. C.

MR. T. SERDUKE, The Madison, Seattle, Wash., is desirous of receiving from manufacturers catalogs in the line of telegraphic apparatus; especially supplies adapted to export. He states that he would like to get two copies of each catalog sent.

MR. E. R. MASON, who has been connected with the sales department of the Chicago branch of the Electric Service Supplies Company and its predecessors for the past 11 years, has been appointed manager of the New York office of the company. He assumed his new duties on the 1st of January.

MR. J. E. COWLES, formerly chief electrician of the Hot Springs Water, Gas & Electric Works, Hot Springs, Ark., has been appointed superintendent of lighting of the Little Rock Railway & Electric Company, Little Rock, Ark. He succeeds at Little Rock Mr. T. R. Phillips, who has found it necessary to go farther South on account of ill-health.

MR. W. J. McCORKINDALE, manager of the Marquette County Gas & Electric Company, of Ishpeming, Mich., is the subject of an appreciative sketch in *Iron Age*, published in Ishpeming. A page of the journal is devoted to an account of the Marquette plant, the occasion of the article being a luncheon in the car barn, at which toasts had leading citizens as respondents.

MR. WALTER E. HOLLOWAY, who was with the Safety Insulated Wire & Cable Company for nearly 20 years, and for a long time its purchasing agent, has now opened an office on his own account in the Produce Exchange Annex, New York City, where he will give special attention to dealings in rubber, copper and cotton yarns, utilizing his knowledge and experience in these and kindred lines.

MR. G. S. SHINNICK, assistant to Mr. W. A. Gibbs, district manager of the Ohio Electric Railway Company, Columbus, Ohio, has become general manager of the Mattoon Light, Heat & Power Company and the Mattoon Railway Company, both of Mattoon, Ill. He is also secretary and a director of the Licking Light & Power Company, of Newark, Ohio. He has had nine years with the various parts of the Ohio Electric system.

MR. ALEX. HENDERSON at the recent meeting in Buffalo of the Rejuvenated Sons of Jove offered a sentiment in proposing a toast that is enjoying considerable fame in electrical circles, but is here given correctly: "A single roseleaf passed before a man while he is alive is productive of more happiness and joy than a mountain of flowers heaped on his grave." Mr. Henderson's eloquence is timely for the new year.

MR. H. A. JOHNSON, engineer of car equipment of the Metropolitan West Side Elevated Railway, Chicago, Ill., has been appointed master mechanic of the company, assuming part of the duties of Mr. E. T. Munger, who has been appointed general superintendent of the Hudson & Manhattan Railroad, New York. Mr. Johnson is a graduate of Purdue University, and has been connected with the Metropolitan West Side for the past three years.

MR. J. CLIFFORD RENNARD, who was until recently assistant chief engineer of the New York Telephone Company, and has since been engaged in consulting work as an electrical engineer, has just returned from the West, where he has been engaged in an inspection of fire alarm telegraph systems for the National Board of Fire Underwriters. Mr. Rennard has his headquarters at 77 East Fifty-sixth Street, New York, and will give his attention to telephony, telegraphy and signaling, as well as the other departments of the field.

MR. J. B. N. CARDOZA has resigned as assistant to the general manager of the Norfolk & Portsmouth Traction Company, Norfolk, Va. He left the Berkley (Va.) Street Railway several years ago to become superintendent of maintenance of way of the Norfolk & Portsmouth Traction Company and served in this capacity until the opening of the Jamestown Exposition in June, 1907, when he was appointed assistant general manager. He has now opened an office in Norfolk as a consulting engineer, and will pay particular attention to electric railways and other electrical utilities.

MR. J. E. WOODWELL, of the firm of L. B. Marks and J. E. Woodwell, New York City, has been retained by Messrs. McKim, Mead & White, architects, as consulting engineer for the entire mechanical and electrical equipment, including the heating and ventilation, electric lighting and power, mail handling devices, etc., of the new U. S. Post Office to be erected at the Pennsylvania Terminal Station in New York City. The cost of this installation will be upward of $500,000. The firm has retained Prof. S. H. Woodbridge, of the Massachusetts Institute of Technology, as associate consulting engineer for the heating and ventilation of this building.

MR. THOMAS F. RYAN, under medical advice, has announced that hereafter he will be actively connected only with the Morton Trust Company, the National Bank of Commerce and the American Tobacco Company, having withdrawn from official connection with all the other companies in which he is interested. Among the companies from which

he has retired as a director are the Central Crosstown Railroad, New York; Thirty-fourth Street Crosstown Railway, New York; Metropolitan Street Railway, New York; New York City Railway, New York; Union Elevated Railroad, Chicago; the Consolidated Gas, Electric Light & Power Company, and the Electric Storage Battery Company.

MR. E. T. MUNGER, heretofore superintendent of motive power and equipment of the Metropolitan West Side Elevated Railway, Chicago, Ill., has become general superintendent of the Hudson & Manhattan Railroad, operating under the Hudson River between New York and New Jersey. He was graduated from the University of Wisconsin in 1892, and became connected with the Hall Signal Company, as draftsman and construction foreman. In 1894 he entered the employ of the National Switch & Signal Company, but resigned a year later to become foreman of construction of the Metropolitan West Side Elevated Railway, in charge of wiring cars, stations and power houses. In 1898 Mr. Munger was appointed engineer of the Englewood & Chicago Railway in charge of the construction and installation of that company's storage battery surface line between Englewood and Blue Island. On the completion of the road he became general manager of the Havana Telephone & Electric Light Company, Havana, Ill., but re-entered the service of the Metropolitan West Side Elevated Railway in 1903 as master mechanic, and continued in that position until March 14, 1908, when he was appointed superintendent of motive power.

MR. WALTER J. JONES, who has been associated for the past three years with the late Dr. F. A. C. Perrine, will continue the consulting engineering practice of Dr. Perrine at the offices, 60 Wall Street, New York City. Mr. Jones was educated at high schools, and after four years in the pattern shop and three and a half years in the drawing office of the Dickson Manufacturing Company, he engaged for five years in the equipping of street railways and the installing of power plants in a number of States. Following this varied experience, he occupied during the next 10 or 11 years responsible positions in the engineering departments of the Suburban Electric Light Company, Scranton, Pa.; the Bergen County (N. J.) Gas & Electric Company; in the sales department of the Stanley Electric Manufacturing Company (Denver and Chicago offices), and as engineer of the American Construction Company, New Orleans. He left the last mentioned company in 1905, and, returning North to engage in general engineering, soon became associated with Dr. Perrine. Mr. Jones is carrying through to completion the work that Dr. Perrine had on hand at the time of his death, including work for the Bishop Creek Gold Company for a power plant and stamp mill, and a hydraulic mining installation for the British Guiana Gold Company. He is consulting engineer for the United States Roller Bearing Company and for the Interstate Railways Company. For the latter he is building a power plant of 10,000 kw at Reading, Pa. This will involve the building of the power plant and changing of the present steam plant into a main synchronous-converter substation, from which will be operated the street railway system, low-tension lighting and power system and street arc lamps of Reading. He will also install four or five other substations in the vicinity of Reading, to supply the interurban trolley systems. The plants include the re-equipment of the water power plant about six miles from Reading.

MR. WALTER J. JONES.

Trade Publications.

AIR COMPRESSORS are described in detail in illustrated catalog No. 100 of the Thos. H. Dallett Company, York and Twenty-third Street, Philadelphia, Pa.

MACHINE TOOLS for making small duplicate parts from metal bars are outlined in Folder No. 515 of the National-Acme Manufacturing Company, Cleveland, Ohio.

POLYPHASE MOTORS, of the wound-rotor and squirrel-cage induction type, are treated in an instructive manner in Bulletin No. 82 of the Wagner Electric Manufacturing Company, St. Louis, Mo.

NERNST LAMPS.—The December issue of *Lux*, a miniature magazine published by the Nernst Lamp Company, Pittsburgh, Pa., contains many bright items on the subject of illumination by Nernst lamps.

ALTERNATORS, of the polyphase revolving-field type, are dealt with in Bulletin No. 1109 of the Fort Wayne Electric Works, Fort Wayne, Ind. The various constructive details are illustrated and described.

MACHINE SHOP SUPPLIES, including hydraulic machinery, pneumatic machinery, shears, punches, rolls, etc., are illustrated and described in the December issue of *Ryerson's Monthly Journal and Stock List.*

CRANE CONTROLLERS, of the variable mechanical pressure carbon resistor type, are discussed instructively in a well-illustrated 40-page catalog issued by the American Electric Fuse Company, Muskegon, Mich.

TELEPHONE PROTECTION.—The Harvard Electric Company, 136 Liberty Street, New York, has issued folders for calling attention to its line of protectors for telephone lines, including fuses and lightning arresters.

GAS ENGINES.—A discussion of the saving that may be obtained in the consumption of coal by substituting gas producers and engines for steam boilers and engines is given in a bulletin issued by the Model Gas Engine Works, Peru, Ind.

ELECTRICALLY DRIVEN TOOLS, including drills, grinders, buffers, notching presses and winding machinery, are illustrated and described in a bulletin issued by the James Clark, Jr., Electric Company, Louisville, Ky. The tools are driven by direct-current motors.

THEFT OF ELECTRICAL ENERGY and its prevention are discussed in a booklet issued by the Pettingell-Andrews Company, Boston, Mass. Illustrations with diagrams of connections are given of a device designated as the "O K connection block," which removes the temptation.

STORAGE BATTERIES for the ignition of gas in engines are listed and described in a bulletin issued by the Radio Battery Company, 16 Boyden Place, Newark, N. J. The bulletin also contains brief descriptions with price lists of charging outfits, rectifiers, hydrometers and voltmeters.

HESS-BRIGHT.—The Hess-Bright Manufacturing Company, Philadelphia, has issued and distributed a perpetual calendar to fit the vest pocket. The company will have a fine exhibit of a scientific nature at the Automobile Shows in New York, illustrative of ball bearings and tests of them.

STEAM ENGINES, of the single-valve side-crank type, are described in detail in Bulletin No. 20 of the Ridgeway Dynamo & Engine Company, Ridgeway, Pa. These engines are built as simple, tandem-compound or cross-compound machines, and are intended especially for driving electric generators.

VIBRATORS.—The Shelton Electric Company, Chicago, Ill., has issued a 36-page catalog devoted to its electrically driven vibrators. Illustrations are given of rheostats, vibrator outfits, hand massage instruments, electric centrifuges, sinusoidal devices, head lamps, hair dryers and curling irons.

ELECTRIC IRONS.—No. 5 of Vol. I. of *Hot Points*, issued by the Pacific Electric Heating Company, Ontario, Cal., calls attention to the fact that the Commonwealth Edison Company, Chicago, has placed an order with it for 5,000 irons. The reasons for the success of its irons are thoroughly discussed.

DIRECT-CURRENT MOTORS of the protected and enclosed types, rated at from 0.03 hp to 20.0 hp, are illustrated, described in detail and listed in Bulletin No. 40 of the Eck Dynamo & Motor Company, Belleville, N. J. The bulletin also contain miscellaneous data to aid in the selection and installation of motors.

M. & M. SPECIALTIES.—The Machen & Mayer Electrical Manufacturing Company, Twelfth and Buttonwood Streets, Philadelphia, has already got out its catalog for 1909 covering its lines of electrical specialties. It has also issued a catalog of its new "M. & M." panel-boards. These are of the multiple push-button switch type.

TELEPHONES.—Circular No. 1078 of the Western Electric Company, Chicago, Ill., is devoted to magneto-telephone wall sets recently placed on the market. In these telephones the binding posts are placed out of sight, and the bell generator and switch-hook have been redesigned, so that the appearance has been much improved over that of older types.

ELECTRIC PYROMETERS of the combined indicating and recording type are illustrated and briefly described in bulletin No. 100 of the Bristol Company, Waterbury, Conn. These pyrometers are especially valuable for annealing furnaces, case-hardening furnaces, water-gas mains, blast furnaces, galvanizing plants, gas producers or open-hearth furnaces.

WIRELESS TELEPHONY.—The Radio Telephone Company, 49 Exchange Place, New York, has issued a series of bulletins dealing with wireless telephone apparatus. Bulletin C-1 relates to condensers of variable capacity, D-2 to combination syntonizers and receivers, L-2 to inductors of variable inductance, L-4 to inductors of wide range of variability, L-5 to loose-coupling apparatus and T-1 to sensitive telephone receivers.

TEXTILE MILLS.—The Western Electric Company has issued an interesting bulletin on electricity in the textile industry, illustrated by some typical installations and special drives where the company's apparatus is used. The reading matter embodies a discussion of the use of electric motors in ensuring steadiness of the driven machines at a higher speed, with consequent increase in output. Among the views are those of warping, redrawing frames, quilling machines, winding and throwing machines, folding machines, etc. The pamphlet shows, in addition, generators, motors and lamps, with descriptive text, and devotes a page to intercommunicating telephones.

GENERAL ELECTRIC FAN MOTORS.—Fan motors for 1909 is the subject of a catalogue just issued by the General Electric Company. This catalogue contains illustrations, descriptive matter and prices of the entire line of its fan motors for the coming season. This line embraced motors for both alternating and direct current in desk, bracket, ceiling, floor column and counter column types of standard sizes. It lists also ventilating motors and miscellaneous small power motors for alternating and direct current, as well as various supply parts of the standard fan motors. The catalogue, No. 4632, quarto size, is attractively printed in green and gray and will be furnished on application to the nearest sales office or to the publication bureau, Schenectady, N. Y.

Business Notes.

THE VAN DORN ELECTRIC MANUFACTURING COMPANY, of Cleveland, Ohio, has opened an office at 239 Fourth Avenue, Pittsburgh, Pa. James A. Bradley will have charge of the Pittsburgh office.

THE CHICAGO X-RAY COIL COMPANY has opened up offices at 1125-26 Masonic Temple, Chicago, Ill., where the latest improvements in this company's electrotherapeutic apparatus are exhibited.

THE STAVE ELECTRICAL COMPANY, New York, manufacturer of the "Stave" flaming arc lamps, has opened a Chicago branch at 1101 Monadnock Block. This will be a great convenience to the Western trade.

WOOD PRESERVER.—The C. A. Manufacturing Company, of Austin, Tex., has arranged with the Western Electric Company, of Denver, Colo., to take charge of its stock of "C. A. wood preserver," thus adding Denver to the list of distributing points.

ILLUMINATING ENGINEERS TO DESIGN GLOBES.—The Phoenix Glass Company, of New York, Pittsburg and Chicago, has retained the Bureau of Illuminating Engineering, 437 Fifth Avenue, New York, to act as consulting and designing illuminating engineers in the matter of designing or redesigning glass globes and reflectors, as manufactured by them, so that beauty and utility will be sensibly blended. Mr. Albert J. Marshall, chief enginer of the bureau, will have direct supervision of this work. In carrying out these ideas the effect of light on the eye will receive very careful consideration.

GRINDING GLASS.—A new method for grinding glass has been discovered, it is stated, by the Onward Manufacturing Company, who have factories at Menasha, Wis., and Berlin, Ont., and are manufacturers of the Onward sliding furniture shoe, which takes the place of the wheel castor. This discovery is a grindstone made from one-half best Portland cement and one-half silica sand. It must be thoroughly mixed and tamped even. The advantage of this stone is that when properly made there will be no hard and soft spots, and it will grind glass without scratching. The cost is about 10 per cent of the common grindstone. Some have been used successfully for one year.

CAPITAL AND LABOR.—During the recent holidays Mr. James Inglis, president of the American Blower Company, Detroit, Mich., made an address to the employees at the works, expressing satisfaction at the cordial relations that existed between the management and the men without break for more than a quarter of a century. Two years ago the company distributed a large sum of money, in giving each employee $1 and an additional dollar for each year of continuous service. The largest sum paid was $24, that representing the entire life of the company. No one received less than the $1. Last year, owing to the business depression, nothing of the kind was done, but this year the same plan, as outlined above, was again adopted.

ELECTRICITY AT THE CORN SHOW.—At the National Corn Show at Omaha, Neb., early in December, was exhibited electrical apparatus suggesting the use of electric power and light for the farm. The Northern Electrical Manufacturing Company, of Madison, Wis., co-operated with the Alamo Manufacturing Company, of Hillsdale, Mich., in showing generating units. There was a 1¾-kw generator driven by a 3-hp vertical gasoline engine in operation supplying current for illuminating the exhibit, operating an electric piano, a flatiron, etc. An emergency circuit was maintained for supplying light for the entire exhibit in case of a breakdown in the city circuit. Another feature was a direct-connected Alamo engine and 3-kw Northern generator all finished in white enamel and nickel plated. The exhibit did much to encourage the use of electricity for modern homes and farm service. The 1¾-kw generating unit was honored by the authorities of the exhibition as a prize to the best one-half bushel of wheat.

LINK-BELT ORDERS.—The Link-Belt Company, of Nicetown, Philadelphia, Pa., has recently received an order for a locomotive coal, ashes and sand station for the Philadelphia & Reading Railway at Ninth and Wallace Streets, Philadelphia. The plans of the station call for reinforced concrete bins, supported by an under-structure of steel, covered with concrete. There will be 12 pockets for coal, two to each of six coaling tracks. Total capacity, 2,000 tons. Ashes will be kept in two pockets having a capacity of 250 cu. yd. Sand storage: six hoppers, three on each side of station, to hold 48 cu. yd. of sand. The conveying machinery comprises duplicate systems, and each will have a capacity of 100 tons per hour of coal, and of ashes 250 cu. yd. in 10 hours. Other installations in Pennsylvania include elevating and conveying machinery at cement mills, paint works, hat manufactory and fueling equipment for a mining company. An open-top carrier will be installed for a contracting firm in New York and an ash hoist for a manufacturing concern in North Carolina.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

ALABAMA LIGHT & TRACTION ASSOCIATION. Secretary, Lloyd Lyon, Mobile, Ala.

AMERICAN ASSOCIATION OF ELECTRIC MOTOR MANUFACTURERS. Secretary, W. H. Tapley, 29 West 39th St., New York. Next meeting at Hotel Schenley, Pittsburg, Pa., Jan. 26, 27 and 28, 1909.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. Albert C. Geyser, Willis Ave., New York City.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, United Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, G. H. Winslow, 559 Frick Building Annex, Pittsburg, Pa. Next meeting, October, 1908.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Room 511, Harvester Building, Chicago. Next meeting, Detroit, June 23, 24 and 25, 1909.

AMERICAN STREET & INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, Walter S. Mower, London, Ont.

AMERICAN STREET & INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York.

ASSOCIATION OF CAR LIGHTING ENGINEERS. Secretary, G. B. Colegrove, Chicago & Illinois Railroad, Electrical Department, Chicago. Next meeting, Chicago, Oct. 5, 6, 7 and 8, 1909.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, S. E. Mumford, Detroit, Mich.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, W. H. Cole, Waltham, Mass. Annual meetings held in Boston, third Wednesday in March.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont.

CANADIAN STREET RAILWAY ASSOCIATION. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

CENTRAL ELECTRIC RAILWAY ASSOCIATION. Secretary, A. L. Neereamer, Indianapolis, Ind.

CHICAGO ELECTRIC CLUB. Secretary, S. M. McFedries, care J. L. Schureman & Co., Chicago.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, J. C. Lawler, Colorado Springs, Col. Next meeting, September, 1909.

EASTERN STATES INDEPENDENT TELEPHONE ASSOCIATION OF PENNSYLVANIA, NEW JERSEY, MARYLAND AND DELAWARE. Secretary, H. E. Bradley, 135 South Second St., Philadelphia, Pa.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, Geo. W. Russell, Jr., 500 Fifth Ave., New York. Next meeting, Imperial Hotel, New York City, Jan. 19, 1909.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Charles J. Sutter, 1220 Pine St., St. Louis, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 209 State St., Room 1002, Chicago. Annual meeting, Chicago, January, each year.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next meeting, Chicago, Nov. 4, 1909.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Friday of each month.

EMPIRE STATE GAS & ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 154 Nassau St., New York.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary, H. E. Chubbuck, Peoria, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, V. R. Lansingh, 33 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

INDEPENDENT ELECTRICAL CONTRACTORS' ASSOCIATION OF GREATER NEW YORK. Secretary, Lewis H. Woods, Imperial Hotel, Broadway and 32d St., New York.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., 1909.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., Eng.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. C. Davis.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. N. Keiser, Des Moines, Ia. Next meeting, Cedar Rapids, Ia., April 21 and 22, 1909.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, W. J. Thill, 208 Des Moines Life Bldg., Des Moines, Ia. Next meeting, Des Moines, March 9, 10 and 11, 1909.

IOWA STREET & INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Cedar Rapids, Ia., April, 1909.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Wichita, Kan., October, 1909.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky. Regular meetings, second Tuesday in October each year.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRICAL ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary-Treasurer, Ludwig Kemper, Albert Lea, Minn. Next meeting, Nicollet Hotel, Minneapolis, Minn., March 18 and 19, 1909.

MISSISSIPPI ELECTRIC ASSOCIATION. Secretary, J. A. Abbott, Jackson Ry. & Light Co., Jackson, Miss. Next meeting, Jackson, Miss., June 15, 1909.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Schweer, Windsor, Mo.

MISSOURI ELECTRIC LIGHT, GAS & STREET RAILWAY ASSOCIATION. Secretary, C. L. Clary, Sikeston, Mo. Next meeting, April 15, 16 and 17, 1909.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, John F. Gilchrist, 139 Adams St., Chicago. Headquarters, 33 West 39th St., New York.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Toledo, Ohio, July 21, 1909.

NATIONAL ELECTRICAL INSPECTORS' ASSOCIATION. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred. P. Vose, 1343 Marquette Building, Chicago. Next meeting, Boston, Mass., June 10, 1909.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, William Bradford, Lincoln, Neb.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 33 West 39th St., New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. M. Eaton, Niagara Falls, N. Y.

NORTHWEST ELECTRIC LIGHT & POWER ASSOCIATION. Temporary chairman, J. D. Crary, Aberdeen, Wash. Next meeting, Seattle, 1909.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, Roger N. Kimball, Kenosha, Wis. Next meeting, Milwaukee, Jan. 20 and 21, 1909.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Columbus, Ohio. Next meeting, Columbus, Ohio, March 18, 1909.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, David Gaehr, Schofield Building, Cleveland, Ohio. Next meeting, Canton, Ohio, May 21 and 22, 1909.

OKLAHOMA ELECTRIC LIGHT, RAILWAY & GAS ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla.

OLD TIME TELEGRAPHERS' & HISTORICAL ASSOCIATION. Secretary, F. J. Scherrer, 195 Broadway, New York. Next meeting, Pittsburg, Pa., 1909.

PENNSYLVANIA ELECTRIC ASSOCIATION. E. L. Smith, Towanda, Pa., secretary.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meeting second Saturday of each month.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, C. E. Russell, Boston, Mass. Monthly meetings, fourth Monday each month. Next annual meeting, fourth Monday in February, 1909.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D. Next meeting, Yankton, S. D., Jan. 13 and 14, 1909.

SOUTHWESTERN ELECTRICAL & GAS ASSOCIATION. Secretary, J. A. Myler, Jr., 609 Juanita Building, Dallas, Tex. Next meeting, Dallas, Tex., May, 1909.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, E. M. White, Box 345, Hartford, Conn.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, Canandaigua, N. Y.

VERMONT & NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. B. Seeley, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, A. B. Marsden, Manchester, Vt.

UNDERWRITERS' NATIONAL ELECTRICAL ASSOCIATION. Secretary, Electrical Committee, C. M. Goddard, 141 Milk St., Boston, Mass. Next meeting, New York, March, 1909.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 125 Monroe St., Chicago, Ill. Next meeting, Detroit, Mich., October, 1909.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1 each year.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED DEC. 22, 1908.

[Conducted by William F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

907,139. JUNCTION OR OUTLET BOX; John Fountain, Jr., Elizabeth, N. J. App. filed Oct. 31, 1907. A cast metal box with wrought metal sides; the openings in the sides being filled with cast metal disks.

907,140. ELECTRIC STERILIZER FOR FOOD PRODUCTS; M. R. Frei, Denver, Col. App. filed May 27, 1908. The vessel into which the liquid is to be poured is provided with outlet openings, and electrodes have their terminals projecting into said openings.

907,155. MANUFACTURE OF SPAR INSULATORS; F. M. Locke, Victor, N. Y. App. filed Nov. 24, 1905. Makes an insulator entirely of feldspar by subjecting it to a very high heat, then molding it into an insulator form and allowing it to cool.

907,161. VACUUM-TUBE ELECTRIC APPARATUS; Danel McFarlan Moore, Newark, N. J. App. filed Feb. 7, 1906. The gaseous tension in the tube is kept uniform by a valve which controls the feed of air or other gas to the tube. Means magnetically actuated by the varying magnetic field of a transformer regulate the position of the valve.

907,165. SIGNAL SYSTEM WITH CONTINUOUS RAIL CONNECTIONS; Daniel J. McCarthy, Wilkinsburg, Pa. App. filed April 25, 1907. Each signal is connected to one relay and two transformers each of the same phase are arranged to supply current through the track to the relay. Either transformer supplies insufficient current to operate the relay, but their combined action controlled by the movement of the train operates the relay.

907,176. ELECTRIC MOTOR; George W. Richardson, Wissahickon, Pa. App. filed Jan. 22, 1907. For heavy mill work. The frame has three bearings on opposite sides. These receive the motor shafts of two motors that are arranged side by side in the frame and of an intermediate shaft in the frame, geared to the two motor shafts.

907,194. WALL-SOCKET BASE; Samuel E. Steele, Pittsburg, Pa. App. filed Aug. 1, 1907. For electric lamps. Provides means whereby the wires may lead to the base either through the rear or through the sides.

907,224. TELEPHONE SYSTEM; William W. Dean, Chicago, Ill. App. filed Aug. 23, 1901. A telephone system having a relay battery permanently connected to the line, which relay is under the control of the subscriber, a ground tap connected with the talking circuit and controlled by the relay and the telephone associated with the cord circuit, having its operation affected by current flowing over a circuit forming a portion of the said talking circuit and the ground tap.

907,246. TROLLEY-HARP WASHER; Hugh W. Kimes, Dayton, O. App. filed April 20, 1908. Means for attaching the washer to the harp. Details.

907,251. ELECTRICAL-WIRING KNOB; Harry Wallace Lawrence, Denver, Colo. App. filed June 10, 1908. A porcelain insulating post for supporting the terminals and intermediate portions of wires. The post is cut transversely so as to make two sections. The wire passes into a gripping recess formed on the ears of the two sections.

907,269. SIGNALING ON TRAINS; J. F. McElroy, Albany, N. Y. App. filed April 30, 1908. A guard-signal system for multiple-unit trains. A number of car units form a series train-circuit. Guard-switches collectively close the circuit. The driver is informed by the signal at his end when the guards have closed the circuit. Details in construction.

907,296. ELECTRICAL CONDENSER; William C. Shinn, Lincoln, Neb. App. filed Aug. 14, 1908. Used in connection with static electric machines. Consists of a cylinder with inner and outer coatings midway between the terminals. A wing on a rod makes contact with the inner coating. Caps close the cylinder and make it air and moisture tight.

907,320. DEVICE FOR TRANSMITTING SOUND-WAVES; Arthur Dare, Philadelphia, Pa. App. filed Feb. 24, 1908. A transmitter for telephones having two connected compartments, one forming the mouthpiece and a series of non-resonant tubes arranged between the compartments.

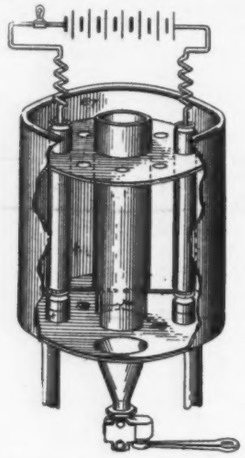
907,339. LIGHT-SIGNAL FOR ELEVATORS; James Monroe Graham, New York, N. Y. App. filed July 22, 1907. Avoids the inconvenience of watching all the signals and sometimes losing a car by providing up and down signal push buttons, and pairs of different colored lights representing ascending and descending elevators arranged in order adjacent to the push buttons.

907,344. ELECTRIC SWITCH; Monroe Guett, Hartford, Conn. App. filed Nov. 1, 1904. A push-button switch in which the poles are advanced a quarter turn and locked in place, and the operating parts return to normal position by a spring.

907,372. STORAGE-BATTERY CELL; P. Kennedy, New York, N. Y. App. filed Oct. 3, 1906. Provides for quickly filling and removing liquid. The jar has an opening at the top which is closed by a cover in two parts, which may be removed without disturbing the terminals.

907,380. MEANS FOR REGULATING ELECTRIC CIRCUITS; Henry Leitner, Woking, England. App. filed March 12, 1907. Regulators for storage battery systems also using a dynamo. The dynamo is a self-regulating variable speed machine with which a rheostat having a movable arm adapted to cut resistances in and out of the lamp circuit co-operates. A motor operating the arm is under the control of a volt meter connected to the lamp circuit. A series of resistances in the shunt field of the dynamo prevent overcharging the battery.

907,399. ELECTRIC HORN; D. P. Perry, Chicago, Ill. App. filed Jan. 27, 1906. The sound producing diaphragm is protected against



907,140—Electric Sterilizer for Food Products.

moisture and dust. Two diaphragms are used with a tapper electrically operated for rapidly beating one of the diaphragms.

907,406. INSULATOR FOR HIGH-TENSION LINES; Norman Rowe, Guanajuato, Mexico. App. filed Jan. 29, 1906. A hollow body, non-conducting, is provided with one or more petticoats. A binding rod of non-conducting material connects caps on opposite ends of the body.

907,419. CONSTANT-LEVEL DEVICE FOR STORAGE BATTERIES; E. W. Smith, Philadelphia, Pa. App. filed Oct. 4, 1904. Eliminates inaccuracy in the working of a storage battery, due to change of level by evaporation, by providing a water supply bottle which feeds water to the battery and a float device actuated when the level of the liquid falls.

907,425. ELECTROPLATING APPARATUS; Abraham Van Winkle and J. T. Daniels, Newark, N. J. App. filed June 29, 1907. A revoluble work support is arranged next to a rotary brush which brushes the work while it is being electroplated.

907,426. ELECTROPLATING APPARATUS; Abraham Van Winkle and John T. Daniels, Newark, N. J. App. filed July 29, 1907. Endless chains support the cylindrical bodies in bulk, in the bight of the chains. The entire apparatus is within the tank.

907,462. TRACTION VEHICLE; C. W. Coleman, Westfield, N. J. App. filed April 5, 1907. A traction engine for agricultural use which draws behind it a trailer. Both trailer and engine are controlled from the seat of the traction vehicle by one man. The engine is driven by a gas engine and the control is electrical.

907,470. TELEPHONY; Hiram D. Currier, Chicago, Ill. App. filed July 20, 1908. A telephone line and transmitting station, a plurality of receiving stations having telephone receivers included in conductors in bridge of the telephone line, the conductors offering different degrees of effective resistance to the voice currents.

907,474. COMPRESSED AIR ENGINE FOR CONDUIT WIRE DRAWING; H. C. Dickinson, Mobile, Ala. App. filed April 8, 1907. Special means are provided for guiding and centralizing the engine in the conduit by means of a truck and centralizing rollers.

907,481. ARRANGEMENT OF CONTACTS FOR SWITCHES; Otto Engel, Berlin, Germany. App. filed March 31, 1908. Makes use of a plurality of conducting segments with insulating layers between. Details.

907,482. SEMAPHORE; John Erickson, Chicago, Ill. App. filed Sept. 19, 1906. Particularly adapted for giving a signal when the selector of an automatic telephone switch is moved to an off-normal position. A flat semaphore blade is moved away from a shield by a motion of the selecting arm.

907,487. STORAGE BATTERY ATTACHMENT; R. J. Fleischer, Milwaukee, Wis. App. filed July 5, 1907. A weighted hydrometer attachment fitted with a gage, and weighted with a chain, which latter collapses when the hydrometer is all the way down in the battery.

907,488. APPARATUS FOR OPERATING MECHANISM FROM A DISTANCE; Gustave Gabet, Rochefort-Sur-Mer, France. App. filed Sept. 29, 1905. Wireless telegraph for operating parts of torpedo boats and the like. A pallet wheel driven by clockwork is advanced at each impulse of the wave train. This closes suitable electric circuits. Details.

907,522. CAR-BARN TROLLEY ATTACHMENT; J. W. Perry, New York, N. Y. App. filed June 6, 1908. For preventing fires in car barns using the underground trolley. When the car enters the barn the current collecting plow is removed and the car actuated by a supplementary trolley and trolley pole, which is lifted into temporary contact with the supplementary wire when required.

907,526. BURGLAR ALARM; Samuel Mathias Reist, Minersville, Cal. App. filed May 2, 1907. A window or door alarm in which the trigger closes an electric circuit to ring a bell, the trigger being actuated by the movement of the door or window. Details.

907,542. GROUND-JOINT CONNECTION FOR ELECTRIC CONDUCTORS; John C. Vogel, Philadelphia, Pa. App. filed Feb. 29, 1908. For grounding electric conductors. A flexible band is wrapped around the conductor and suitable plates tighten the band about the body of the conductor.

907,543. GROUND-JOINT CONNECTION FOR ELECTRIC CONDUCTORS; John C. Vogel, Philadelphia, Pa. App. filed July 3, 1908. In addition to the apparatus of 907,542, the patentee provides a lock for connecting the free end of the band with one of the plates.

907,567. ALTERNATING-CURRENT WATTMETER; C. A. Brown, Chicago, Ill. App. filed Dec. 3, 1903. A torque on the movable element proportional to the watts is produced by means of a single energizing circuit which receives its current by induction.

907,568. ALTERNATING-CURRENT WATTMETER; C. A. Brown, Chicago, Ill. App. filed Nov. 27, 1905. A modification of the specific form of meter described in patent No. 907,507.

907,578. ALTERNATING-CURRENT COMMUTATOR DYNAMO-ELECTRIC MACHINE; Wladimir Doinikoff, Karlsruhe, Germany. App. filed March 6, 1908. Avoids sparking in alternating-current machines having a commutator by providing an auxiliary iron core upon which the connecting wires between the commutator and armature are wound and commutating poles suitably arranged to influence the connecting wires.

907,581. TELEPHONE SYSTEM; Alfred H. Dyson, Chicago, Ill. App. filed Nov. 14, 1904. Details in a signaling system for telephones.

907,582. TELEPHONE SYSTEM; Alfred H. Dyson and Francis W. Dunbar, Chicago, Ill. App. filed June 21, 1905. Details in an automatic switch telephone system.

907,598. METHOD OF PRODUCING COLORED LIGHT RAYS; P. C. Hewitt, New York, N. Y. App. filed April 3, 1901. Improvement in the art of fluorescence which makes use of a reflector having a fluorescing surface so that the light reflected therefrom is mingled with the light from the source, the source being a mercury-vapor lamp.

907,600. TRANSMITTER; R. M. Hopkins, Yonkers, N. Y. App. filed May 11, 1908. A telegraph transmitter having a knotted disk and contact device operated by passage over the notches of the disk and one or more adjustable pieces adapted to close one or more of the notches to prevent operation of the contact device.

907,604. KEYBOARD TELEGRAPH SYSTEM; C. K. Jones, Rosedale, Kan. App. filed April 28, 1908. Details in a system for increasing the speed of transmission.

907,614. COMBINATION AND MANAGEMENT OF ELECTRIC CIRCUITS AND THEIR APPLICATION TO RAILWAY SIGNALING SYSTEMS; Joseph Lemire, Drummondville, Quebec, Canada. App. filed Oct. 3, 1907. The track is divided into sub-blocks. A signal operating circuit includes an element of each independent circuit. A plurality of pairs of contacts are arranged in the signal operating circuit and means controlled by each sub-block open the contacts of one pair and close those of the remaining pair.

907,637. PROCESS FOR SEPARATING CREAM FROM MILK; R. W. Padden, Kansas City, Mo. App. filed Aug. 12, 1905. A series of electrical impulses are passed through the milk by an alterating current of high potential or by a uni-directional current.

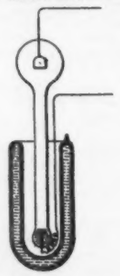
907,658. TELEPHONE SYSTEM; Harry G. Webster, Chicago, Ill. App. filed Jan. 13, 1906. A telephone line extends from a substation in two limbs to a central office and a two-strand link circuit makes connection with the limbs. A signal under joint control of the operator and subscriber is controlled by the operator by closing a circuit including portions of the link circuit and a number of cells of battery, and the signal is controlled by the subscriber by a circuit also including the same battery cells and parts of the link circuit.

907,659. TELEPHONE EXCHANGE SYSTEM; H. G. Webster, Chicago, Ill. App. filed Feb. 12, 1906. Improvement in telephone system; see 907,658.

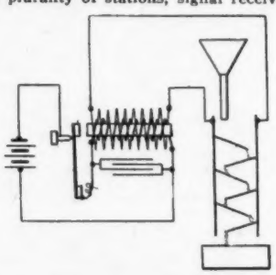
907,660. TELEPHONE SYSTEM; H. G. Webster, Chicago, Ill. App. filed Feb. 12, 1906. A relay with means under the control of one station for closing a circuit through an energizing winding of the relay so as to change the normal position of its contacts and means under the control of the other station for shunting current from the winding to reduce the energization to an amount insufficient to cause the change, a signal and a controlling electromagnet, with its winding in the shunt path.

907,661. TELEPHONE SYSTEM; H. G. Webster, Chicago, Ill. App. filed Feb. 19, 1906. A telephone line extending in two limbs between two stations with a high resistance heat coil and a high resistance electromagnet in circuit and means for completing a talking circuit over the line, excluding the heat coil and connecting the magnet and bridge of the line limbs.

907,662. TELEPHONE SYSTEM; H. G. Webster, Chicago, Ill. App. filed July 5, 1906. A central office with a signaling circuit extending by two limbs from the central to a plurality of stations, signal receiv-



907,598—Method of Producing Colored Light Rays.



907,637—Process for Separating Cream from Milk.

ing devices at the stations associated with one line limb and means controlled over the opposite line limb for controlling the connection with the devices and other signals permanently connected to the opposite line limb.

907,668. BLOCK-SIGNALING APPARATUS; Stephen A. Wood, Providence, R. I. App. filed Feb. 14, 1906. A lamp circuit which is normally open is automatically closed when the first car enters a block, and is again automatically opened and closed when a subsequent car enters the block.

907,686. AIR-BRAKE APPARATUS; C. E. Duffie, Omaha, Neb. App. filed April 27, 1907. In combination with the train line, a main reservoir and means for opening the line to atmosphere, means for cutting off the main reservoir from the line and electrical means for holding both of said means in inoperative position.